SCIENTIFIC AMERICAN

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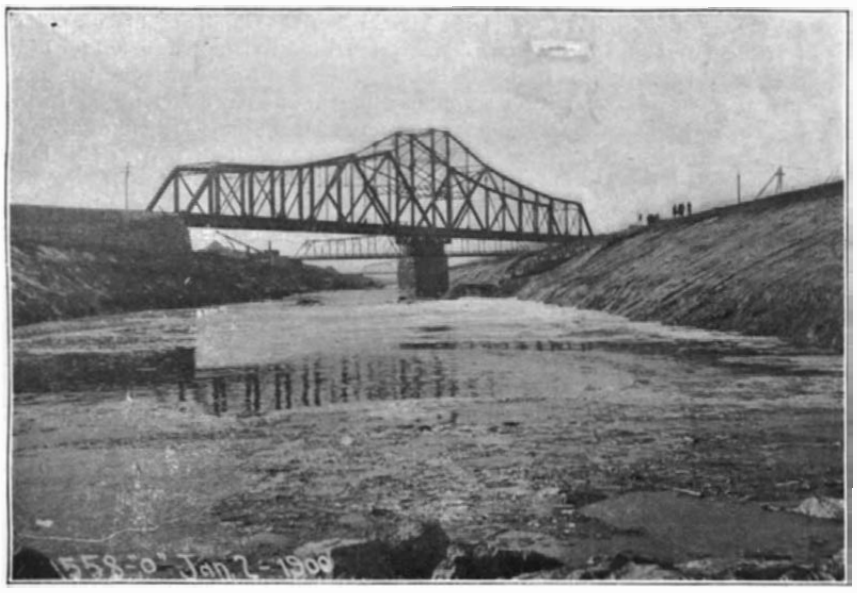
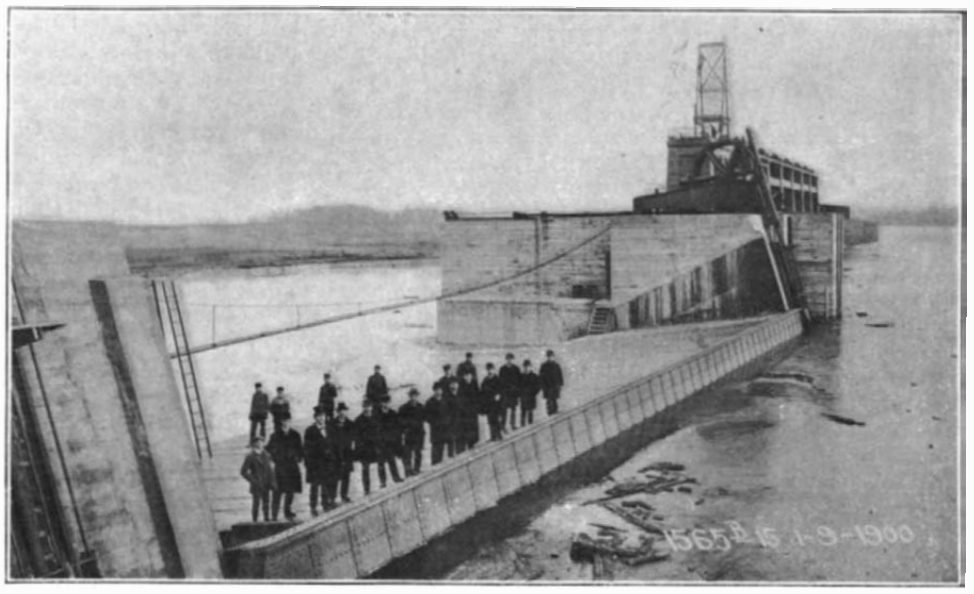
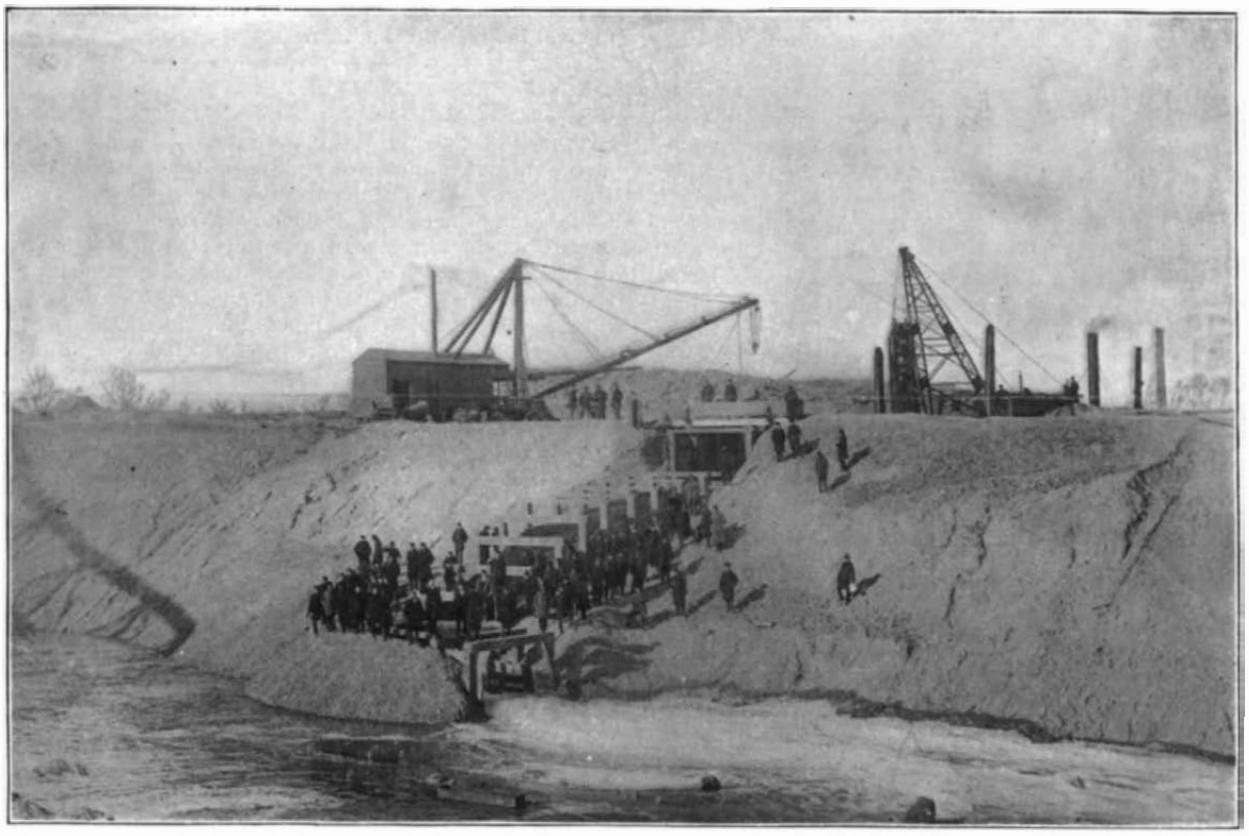


View Taken 45 Minutes after Turning Water into Canal.

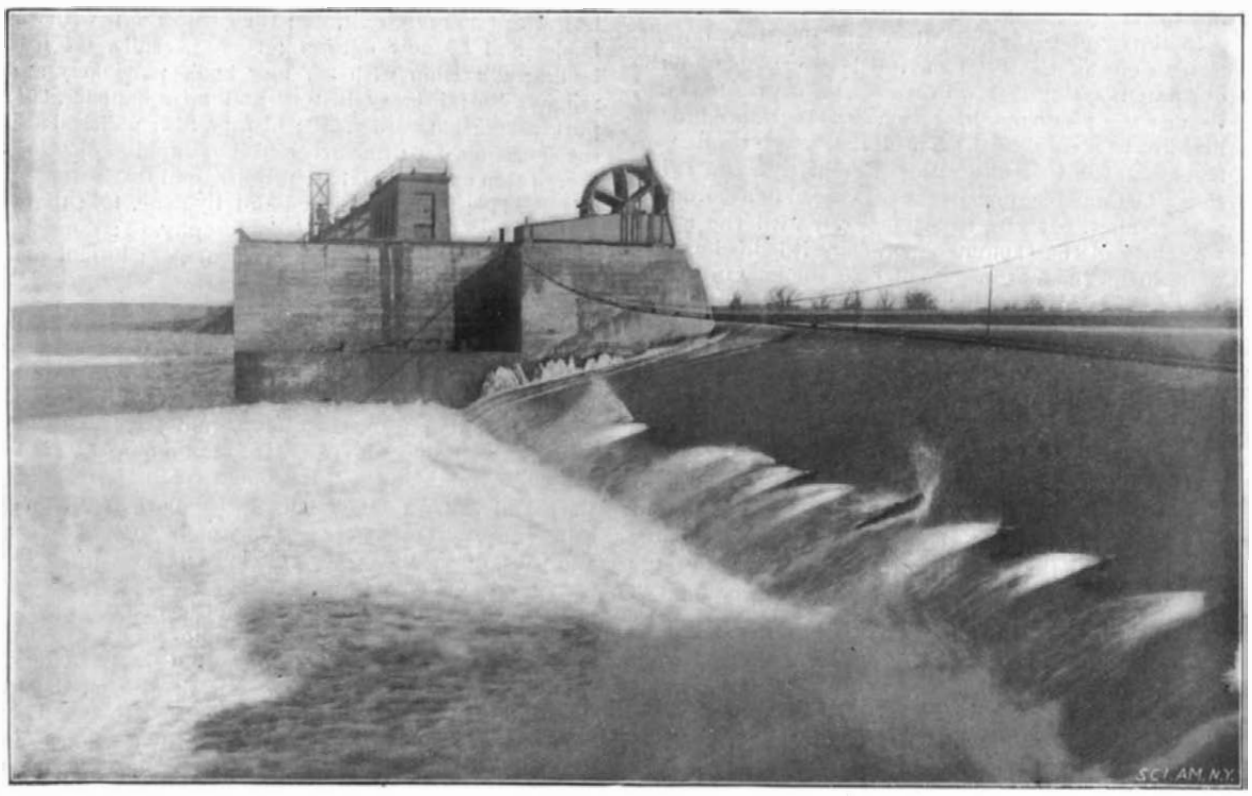


Bear Trap Dam, with a Group of the Trustees of the Canal.

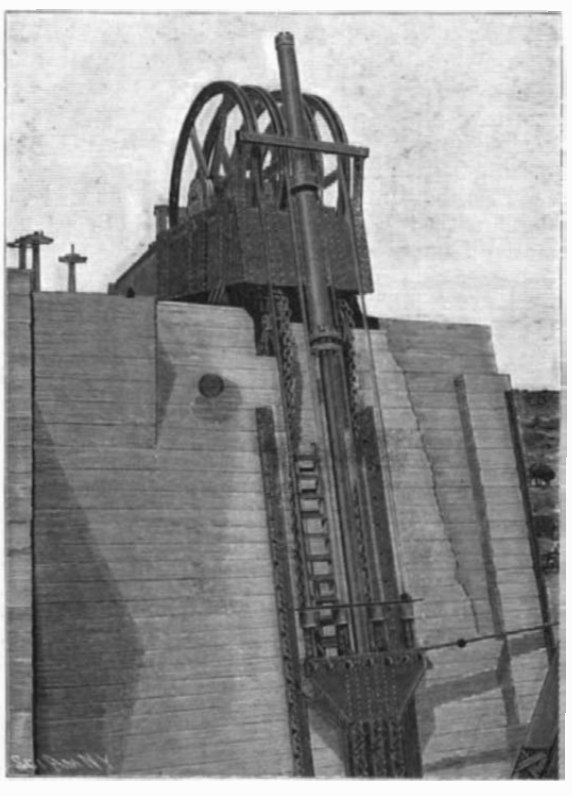
Bear Trap Dam—Two Feet of Water at Crest.



Turning the Water into the Canal, January 2, 1900.

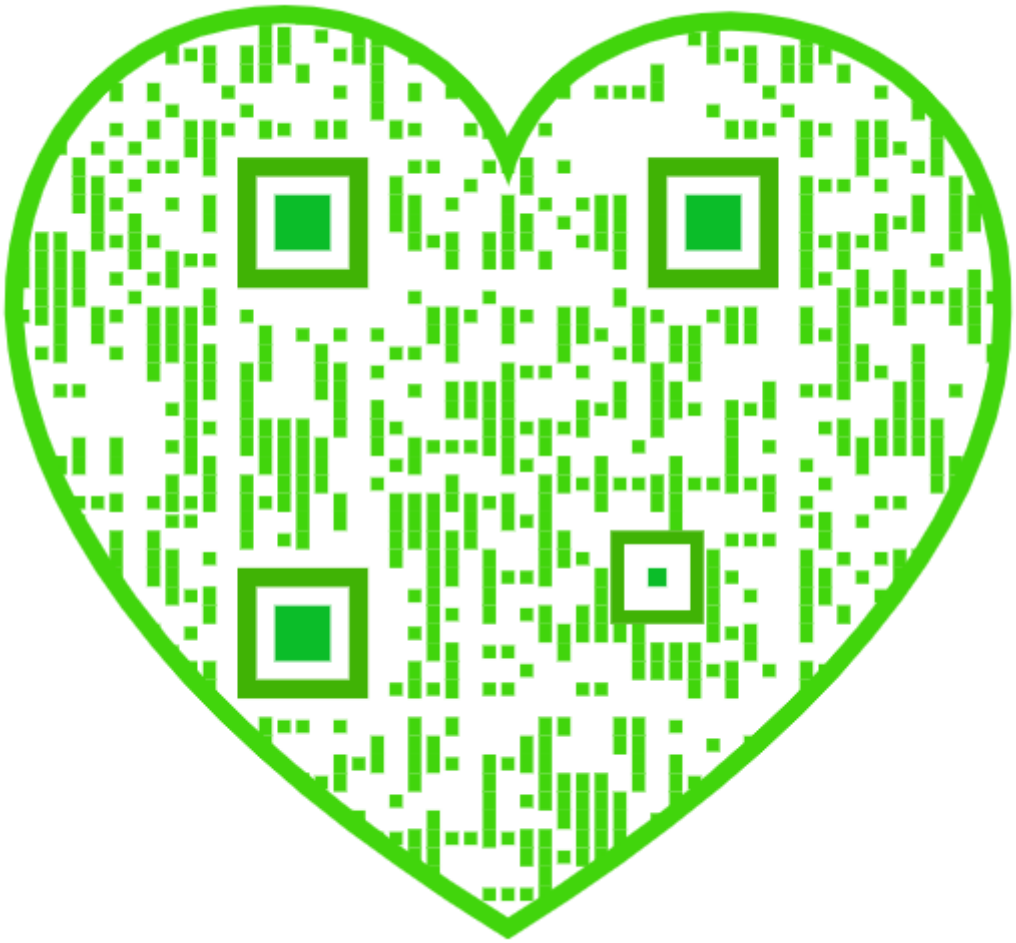


The Great Bear Trap Dam in Operation—Discharge, 100,000 Cubic Feet per Minute.



Bear Trap Dam Controlling Gear.

OPENING OF THE CHICAGO DRAINAGE CANAL.—[See page 105.]



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NEW YORK, SATURDAY, FEBRUARY 17, 1900.

THE AMERICAN PACIFIC CABLE.

It is fitting that the close of the century should find the great project, too long delayed, for a trans-Pacific cable at last fairly launched. Ever since the laying of the Atlantic cables showed the enormous usefulness of this means of communication, the military and commercial value of a cable across the Pacific Ocean has been admitted. The urgent need for its construction was brought home with the strongest emphasis to this country by the stirring and epoch-making events of the Spanish-American war.

In the current issue of the SUPPLEMENT we publish a comprehensive paper by George Owen Squier, which reviews the present status of the trans-Pacific cable question, and shows the route determined upon for the British cable and the alternative routes which are now being surveyed for the proposed cable of the United States. The scheme for a British Pacific cable connecting Canada with Australia has, from the very first, been judged from a national standpoint, both in respect of its strategic and commercial aspects. A Pacific cable, touching only soil belonging to Great Britain, is now assured, both of the colonies named having pledged themselves to assist in the undertaking.

The British cable will be laid from Vancouver to Fanning Island, which lies about a thousand miles due south of Honolulu, the distance from Vancouver being 3,205 miles. From Fanning Island it will run by way of the Fiji Islands to Norfolk Island, from which point there will be two branches, one to Auckland, New Zealand, and the other to Sydney, New South Wales. This cable will complete the telegraphic circuit of the globe and will consequently place every telegraphic station upon it in the advantageous position of being able to communicate with every other station by two distinct routes east or west. The determination to have the stations entirely on British soil has involved the disadvantage that the only available route fulfilling this condition involves a single span of cable between Vancouver and Fanning Island, which will be over 3,500 miles in length. Since the speed of sending cable messages decreases with the square of the length of the cable, and the speed of the whole system is limited necessarily by the speed of the slowest section of it, the British line with its unusually long span is at a decided disadvantage with respect to any other that is not so inconvenienced.

In the proposed American cable route which is now being surveyed, there will be no span over 2,500 miles in length, and, consequently, from a commercial standpoint at any rate, it will be at a great advantage compared with its British competitor. As regards the Alaskan route running by way of Sitka, Kadiak Island, Attu, Japan, Siberia and Formosa to Luzon, which would aggregate in length 5,550 miles, it is enough to say that it would not realize the ideal of telegraphic communication, free from foreign control, between the United States and its Pacific possessions, inasmuch as it would necessitate about fifteen separate stations, of which nearly one-half would be under Japanese control.

From a technical and engineering standpoint there is nothing to prevent the construction of the proposed American Pacific cable. A preliminary survey between the Pacific coast and the Hawaiian Islands was completed by the Navy Department in 1892 which proved that this part of the route was entirely practicable; and thanks to the activity of the Bureau of Equipment of the United States navy, presided over by Rear-Admiral Royal B. Bradford, the United States ship "Nero" has been engaged since April last in a survey of the bed of the Pacific from the Hawaiian Islands westward by way of the island of Guam to the island of Luzon, and northward from Guam to Yokohama. The preliminary report of this survey, recently published, indicates that the route which is being surveyed will prove entirely practicable, and we have just been informed by Admiral Bradford that data received since the publication of the report confirm the practicability of the routes laid down on the chart. The whole line, including the first section, would run from San Francisco to Honolulu, 2,078 miles, from Honolulu to Midway Island, 1,140 miles, Midway Island to Guam, 2,293 miles, Guam to Manila, 1,360 miles. The distance as given above must be increased by 10 per cent to allow for slack in estimating the length of the cables. It is considered by Mr. Squier that the American cable should be so connected with the British cable as to furnish each system with all the advantages of a duplicate line. This could be done by connecting the American cable at Honolulu with the British cable at Fanning Island. With this single span, which would be about 950 nautical miles in length, each country would practically safeguard its own line against a total interruption of business, the messages in case of a break on either side of this connecting line being sent by the unbroken line as far as Honolulu or Fanning Island, and sent thence by the lines of the other company. It is also suggested that a short span of cable of about 200 miles between Luzon and Formosa, connecting with the Great Northern Telegraphic Company's route through Siberia, and another cable between Luzon and a Chinese port, would serve to bring Japan and China into direct communication with North America, and by two competitive routes, east and west, with Europe.

A study of the question from a commercial standpoint, based upon the actual business done with our Pacific possessions by way of the present route, gives every reason to believe that the project would prove to be a paying investment from the very first. Its opening will lead to the immediate lowering of the rates to the East, and the construction of the cable would have the by no means unimportant indirect result of promoting the cable-making industry in this country. Of the strategic value of a cable "wholly under the control of the United States"—to quote the words of the President in his annual message—it is impossible to speak too highly. Its construction is the next logical step to the acquisition of the Hawaiian and Philippine Islands and the consolidation of our naval and commercial interests in the East.

AN EXTRAORDINARY PATENT DECISION.

In last week's issue of the SCIENTIFIC AMERICAN SUPPLEMENT, we published an interesting analysis by Mr. Arthur F. Kinnan of a decision rendered by the United States Court of Appeals for the District of Columbia in the case of Bechman vs. Wood—a decision of unusual importance to inventors because it is so completely opposed to the time-honored practice of the Patent Office, and because, if allowed to stand, the Commissioner of Patents must make it the basis of future rulings which will often defeat the rights of inventors.

The case which called forth the decision in question was not essentially different from many similar contests which the Commissioner is called upon to decide. Wood filed application for a patent and defined his invention in a limited claim. Two years later Bechman applied for a patent on a specifically different device performing the same function, and claimed his invention in terms so broad that Wood's construction was included. A year later Wood filed a claim similar to that of his rival. In the interference proceedings instituted by the Patent Office in such cases, it was decided, in accordance with the usual practice, that Wood being the first inventor was entitled to the broad claim. Bechman appealed; and the Court of Appeals rendered the strange decision that neither inventor should have the broad claim, because Wood, although the first to conceive, had not properly claimed his device until Bechman had applied for a patent, and that Bechman was not justified in receiving the claim because he was not the first inventor.

In thus ruling the court has acted in direct opposition to one of the fundamental laws which underlie our patent system, a law in which it is expressly stated that a patent for a new invention shall be granted to the first inventor (Sec. 4904). The decision, as a result, conflicts with the long-established Patent Office practice, since the Commissioner has always acted in accordance with the law. It interferes moreover with the statutory duty of the Commissioner, since it is his business to decide in the first instance who is the true inventor, and to grant to that inventor a patent for all that has been invented.

It is a principle well recognized in patent law, and moreover a principle with which the Court was evidently familiar, that the first inventor of a species is necessarily the inventor of the genus in which the species is included. The inventor often knows not whether he has invented a genus or no. Since it is the Commissioner's duty to act for the inventor as well as for the community, he co-operates with the inventor in determining the novelty of the invention and grants Letters Patent in which the new features are properly described and claimed in accordance with the statute. The inventor in order to secure the genus to which he is justly entitled has the privilege of amending his application to broaden his claim; and higher courts have recognized that, even in the face of a patent issued while his application is on file, he has the right to enlarge his patent, provided he does not change his invention (Singer vs. Braunsdorf; Western Elec. Co. vs. Sperry Elec. Co.) In the case upon which the Court largely based its decision, the specification had been so modified and the original conception so far lost that a new invention had been created. The error of the Court, as Mr. Kinnan has pointed out, is due partly to a misinterpretation of the word "enlarge;" for it construed the term popularly instead of giving it the specific meaning which it has acquired in patent law.

The decision will place one of two contestants in similar cases in the very peculiar position of being unable to concede to his rival the whole right to an invention. Not infrequently it happens that an interference is asked by an inventor solely for the purpose of enabling him to ascertain who is the prior inventor; and it appearing to his satisfaction that his opponent has actually antedated him, it is not unusual for him, as the defeated one, frankly to acknowledge the other's right by conceding the interfering claim, and thus facilitating the grant of the patent, instead of appealing. Will not the present decision frustrate this honest practice among inventors in many cases?

Priority of invention was awarded to Wood because his filed application, which in law is a "constructive" reduction to practice, antedated the invention of Bechman. The decision will inevitably, in many future interferences, penalize an early filing of an application, if such application be an inadequate though earnest effort by the inventor to comply with the most technical of all the requirements governing patent claims. But in many interferences, an actual reduction to practice by the making of a machine is relied upon for priority. And here the Court was led into the error of giving to Wood's application a significance other than that of a mere equivalent to an actual reduction to practice. Had Wood preceded Bechman's filing date by an actual instead of a constructive reduction to practice, the filing of Wood's application might properly have been subsequent to Bechman's filing of the broad claim without in any way affecting the question of priority; and so long as the invention had not been in public use two years, delay in filing the application would have been within his rights.

Assuming an actual reduction to practice, it follows that the application of Wood and his broad claim might, according to the decision, have been profitably delayed until after Bechman had filed his. Indeed, with an actual instead of a constructive reduction to practice he would have prevailed over Bechman even had he filed his application after a patent had been issued to Bechman, and might even have copied Bechman's claim to emphasize the issue. It must, therefore, be evident that, to have made the broadening of Wood's claim or his delay in presenting a broad claim the basis of the decision is without justification in law, in reason, or even in policy.

OUR BOOKS IN 1899.

The Publishers' Weekly each year tabulates the number of new editions which have appeared during the year. The year 1899 left the impression of being an abnormally busy one to the publishers, and a reference to the figures shows that this is the case. Of new books, 4,749 were issued during the year, and there were 572 new editions, making a total of 5,321; 3,626 books, including new editions, were by American authors and were manufactured in the United States; 571 of the books were by English and other foreign authors, including new editions, and these were manufactured in the United States; and 1,124 books were by English authors and were imported, bound or in sheets, into the United States, making the total already given of 5,321. Fiction naturally leads the list with 749 new books and 183 new editions; then comes law with 454 books and 35 new editions; then juvenile, 434 new books; education with 397 new books; theology and religion, 393; literary history and miscellaneous, 304; poetry, 302; biography, 288; history, 246; political and social science, 226; fine arts and illustrated books, 194; description and travel, 190; physical and mathematical science, 176; medical science and hygiene, 120; useful arts, 99; mental and moral philosophy, 63; domestic and rural, 55; sports and amusements, 43; humor and satire, 26.

WOMEN IN SCIENCE.

At a recent meeting of a society of ladies in Brooklyn, Mrs. A. E. De Friese took up the subject of women's contributions to science and gave as examples Miss Fleming, who recently found a new star; Miss Dorothy Klumpke, the first woman to obtain from the Paris University a doctor's degree in mathematics and astronomy. Miss Charlotte Scott, of Bryn Mawr, Miss Whitney, of Vassar, and Miss Byrd are all three astronomers of good standing. Mrs. Brown-Davis is one of the chief computers upon The Nautical Almanac, and Florence Bascom was recently employed by the government to make a geological survey of Chester County, Pa. Various women inventors were also cited, and Mrs. De Friese concluded by saying that this activity of women is rich in results. The fortunate inventors sometimes secure large royalties, and the inventions being of so practical a nature, the labor of thousands of women is lessened by their introduction.

THE CHICAGO DRAINAGE CANAL.

Elsewhere in this issue will be found a technical description of the Chicago drainage canal, and in this connection a brief review of the considerations which led to its construction will be of timely interest.

It was the modern problem of urban life—the perennial supply of pure water and the sanitary disposition of the sewage—which brought the drainage canal into existence. There is evidence enough to even the transient visitor in Chicago of the need of a new order. The offensive odor from the stagnant, sewage-laden waters of Chicago River especially in summer is a daily and deadly menace to the health of the community. The emptying of the city's sewage into Lake Michigan, whence the city's supply of drinking water is drawn, is contrary to all laws of hygiene and sanitation. The water supply and sewerage system of Chicago have long been unsatisfactory. Something had to be done.

Among the relief measures proposed, the drainage canal seemed most desirable and feasible. Its advantages were convincing. To reverse the flow of the Chicago River away from the lake; to restore the ancient western discharge of Lake Michigan into the Desplaines valley; to utilize the connection thus made with the swift current of the Mississippi; to inaugurate an internal navigable waterway which would not only dispose of all the water and waste of Chicago, but also of every community upon its banks—these were the main features of an undertaking which it is seen is one of the boldest for the improvement of internal navigation which has ever been seriously conceived and conducted by engineers anywhere in the world. While New York, Philadelphia, and Boston are put to tremendous and continual outlay to secure a good water supply, Chicago by its audacious expedient is conserving and safeguarding an inexhaustible reservoir at its door. Furthermore, the connection of the sanitary canal with the scheme for a navigable waterway to connect the Great Lakes with the Mississippi River and the Gulf of Mexico renders the project of more than local importance. The only outlet at present for lake vessels is through a canal on Canadian territory, around Niagara Falls. Commercial interests in the West and South are uniting in support of a demand that the Federal government take a hand in carrying out the contemplated plan.

On the other hand, however, considerable opposition has blocked the way. The project has had to cut its way through seemingly dead walls of litigation. The effect of the new outlet on the lake levels has been a prolific source of discussion. The cities along the lower lakes have been greatly exercised as to the possible effects of the drainage scheme on the depth of water in their harbors and channels. In view of the shallowness of Erie harbors and of the fact that the government has recently completed its work of deepening the navigable channels ten feet, at a cost of $2,000,000, the question of the danger of lowering levels seems to become serious. As on all technical matters, authorities have differed. While some experts have held that the new channel will permanently lower the level of Lakes Michigan, Huron, and Erie from three to eight inches, and thus cause a corresponding reduction of from 240 to 700 tons in carrying capacity for the large vessels of the lakes, other eminent engineers have contended that the effects on the interests of navigation are immaterial (possibly 3-10 foot reduction), and even if they be considered serious, that the remedy may be easily applied. The remedy involves the storing of water in Lake Superior and letting it down when needed, an enterprise which is a story in itself.

The inland cities south of Chicago have naturally shown a lively interest in the proposition. They have begun a series of tests of the character of the water in the Illinois River, which tests are to determine the degree of impurity caused by the sewage discharge. The question of overflow has also been a moot one among dwellers along the river banks.

It is St. Louis whence naturally emanates the most serious opposition. This obstruction first culminated in a report by an investigating committee which implied that Chicago is bound to purify the sewage before casting it upon the waters to contaminate the water supply of a neighboring city, for St. Louisans drink the Mississippi River water without filtration. As such a purification plant would cost $50,000,000, and $3,000,000 annually for maintenance, to construct it is asking a good deal even of Chicago. An injunction suit, entered by St. Louis, January 22, is now pending in the United States Supreme Court, on which action will be taken April 2.

In consequence of all that is involved, the ship canal is a necessary and inevitable result of the work which has created the largest artificial waterway yet constructed. As long as a tangible scheme is held out as a practical project of the early future, it appears to the impartial observer that the people bordering the lakes should be willing to put faith in the well-supported statements of the Chicago engineers, as should the people along the Illinois and Mississippi Rivers be willing to waive their doubts on the sanitary side. The attitude of St. Louis in the matter, in view of its own method of sewage disposal, seems quite inconsistent.

EMPLOYING THE CARABAO FOR ARMY PURPOSES IN THE PHILIPPINES.

The relative value of the mule and the carabao, or, as it is commonly called, the water buffalo, for army purposes in the Philippines has been a subject of speculation and experiment during the operations of our army in the archipelago through the rainy season. The almost indispensable character of the carabao to the natives made it seem advisable to try the creature for transport service in place of the mule, and several trains of ammunition and provisions have been carried in the rear of our army by the buffaloes. These bull trains for transportation purposes have proved a success under certain conditions. Where haste and dispatch are necessary they are dismal failures, but if no particular hurry is essential to the expedition, they offer some points of superiority to the mule train. They are more to be depended upon in hot, wet countries like the Philippines during the rainy season than the army mule, but in any other land they would be of little use. The bulls are as strong as almost any animal in existence, rivaling the elephant in their ability to haul whatever they are hitched to; but they are large, clumsy, slow, and phlegmatic animals. They cannot be driven faster than their ordinary gait, which at the best is almost at a snail's pace. As an instance of their slowness, an army train of bulls was recently dispatched with a load of provisions and ammunition from the Bagbag River to San Fernando. Although only a distance of 12 miles, it took the bulls over half a day to cover the distance.

The peculiar necessity of their bathing frequently in the rivers in order to keep up their spirits and strength during a journey is both an advantage and disadvantage. In traveling through the country in the rainy season, rivers and swollen streams are encountered every mile or so, and crossing these is a pleasure rather than a disadvantage to the carabao. In fact, they must bathe frequently, or they will succumb to the heat and fatigue of the journey. If given all the bathing they want, the carabao bulls will work continuously, and never show signs of exhaustion; but cut them off from all water for any length of time, they will drop down dead in harness. This dependence upon water for bathing, and their great slowness, are the chief points against them.

The flies, mosquitoes, and other insects in the Philippines are so large and numerous that even the mules are seriously disturbed by them, but the carabaos after bathing in the muddy streams have their bodies so coated with mud and slime that the insects cannot bother them. It is partly for this protective purpose that they roll in the muddy bottoms, for undoubtedly long experience has taught them the value of this coat of dry mud.

The government has bought up considerable droves of these animals for army uses, and they are employed constantly in carrying pack trains across the rough country when the mules are needed for other purposes. Our men have not yet thoroughly learned the art of driving and controlling these strange beasts of burden. The Chinamen are the best drivers of the carabaos, and a "Chino" driver is employed for every one that is sent out with a provision train. The animals are quiet and docile if handled properly, but if crossed or angered they show a temper and power that makes them more formidable than the native warriors to fight off. The "Chino" drivers know how to favor the beasts, and when to give them water and when to make them leave the stream. With stones and loud shouts they force the animals to come out of their bed of water and mud and stand up in line for yoking again. Sometimes, however, half an hour is wasted in getting the carabaos harnessed ready for resuming the journey. They are trained so well that they step into line and over the shafts as carefully as a gentle horse waiting to be harnessed.

The animals are rudely yoked to the carts, and are driven by means of a rope fastened to a ring in their noses. The "Chino" drivers control them by means of this rope and loud shouts similar to those used by a farmer in steering his yoke of oxen. The animals are so slow of foot that they were ruled off the principal street of Manila because they impeded the progress of traffic and caused frequent trouble. The beasts are able to strike a good gait, however, as witnessed many times in runaways. Then they show a fleetness of foot that surprises all who are not thoroughly acquainted with them, but their hide is so tough that the drivers cannot prod them deep enough to force them to a faster trot. A wild carabao is not an agreeable animal to meet, and there are immense herds of them roaming in the islands. Several times they have charged upon our soldiers in anger and caused a sensation of more importance than a charge of the native soldiers. With their long horns and powerful muscles they are able to give a whole regiment all the work it needs for a short time. The bullets from the rifles do not always kill or even cripple the wild beasts, and a charge cannot be checked by a volley or two from well-directed rifles. The shooting sometimes serves to anger the animals instead of intimidating them, and they plunge through the deep grass and jungles like a maddened herd of elephants, and sometimes prove almost as formidable.

These wild buffaloes come from the interior, where many natives spend their time in capturing and taming them. It takes a long time to tame the wild creatures and break them into service. Some old bulls absolutely refuse to be tamed, and they show their resentment for capture up to the time of their death. Most of those in service are born and bred in captivity, and the young calves are very easily trained for use. Still enough of the wild carabaos are caught every year to keep the stock from degenerating. They take to civilized life much more readily than our American bison, resembling in this respect the true water buffalo of India.

The strength of these animals is marvelous. In respect to size, strength and ponderousness they resemble the elephant more than any other creature. They simply haul anything that is hitched behind them, and it is the shaft or traces that break if the load cannot be moved. Across all sorts of rough and miry country they pull the load, although they have not the sure footing of the mule in climbing steep and rough mountains and hills. They are better in the soft, miry lowlands which compose so large a part of the Philippines. When angered and running away, they dash across the country with their heavy load as if it was so much light, flimsy cotton. Not only are they then regardless of what is behind them, but also of what may rear itself in front. Be it a river, a fence, ditch or jungle, or another cart, the maddened animal plunges blindly through or across it, and never halts until disabled or its anger has evaporated. In the latter case it then suddenly becomes as meek and docile as before. If whipped for its misdeeds, its meek eyes seem to ask why it is punished, and they look as innocent as those of a child or a deer. In truth it is a strange animal, and not much unlike the natives of the islands which it inhabits. G. E. W.

FACTORY INSPECTION OF NEW YORK STATE.

The "Annual Report of the Factory Inspectors of New York State" makes a volume of 950 pages, and gives a mass of statistical information which is most interesting. During the year the inspectors have visited 35,716 separate establishments and factories, and many of them were in out-of-the-way villages, and it required considerable time and travel to reach them. Altogether, the total number of places visited one or more times was 48,800, and out of this number 15,192 had orders issued against them. The total number of accidents of all kinds reported in factories was 1,626, the total number of fatal accidents in manufactories was 45. The interest manifested by the people of the State in the work of the department is very gratifying. The importance of the provision of the law relative to scaffolding, ropes, etc., has not been fully realized but by a very few of even those whose interests are protected thereby. Five complaints were made about defective scaffolding, and in each case a full compliance of the law was secured. During the year the department found 20,191 children between fourteen and sixteen years of age employed in factories, etc., throughout the State. The total number of certificates for children under sixteen years of age filed by the various Boards of Health throughout the State was 16,240. The department devoted its attention with marked success to the question of fire escapes, labor laws relating to the hours of work, ventilating tenement houses, workshops, etc.

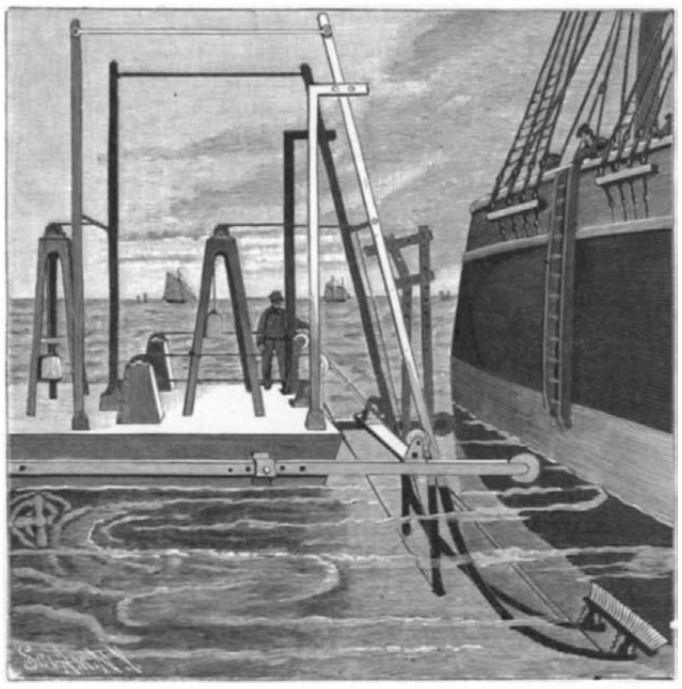
THE NEW GOVERNMENT PRINTING OFFICE.

The new building for the Government Printing Office is now being erected at North Capitol and L Streets, Washington, is to be seven stories in height, and is, of course, thoroughly fireproof. It is to be provided with twelve electric elevators which will run in shafts lined with glazed brick. In case of fire, four large stairways will furnish a means of exit. All the presses are to be actuated by electricity; the larger ones are to have independent motors. The current will be supplied from an adjacent power house. Everything is to be done to make it in every way a model printing office, and when the vast number of books and documents issued by the Government is considered, it will be seen that it will be most economical for the Government to have the best possible plant obtainable. The public printing office supplies every Custom House, Land Office, Internal Revenue Office, Pension Agency, Post Office, the Consular Service and all of the Departments with all the blanks they need, this alone requiring an enormous job printing plant. Special attention is given to doing work with great celerity, as is often required in Congressional matters, and in emergencies the work is done at night. Thus, the manuscript report of the "Maine," of which we have already published an abstract, was received at six o'clock P. M. on March 28, but complete copies bound in paper were on the desks of the members of Congress at ten o'clock the next morning.

A NEW WAY OF CLEANING SHIPS' BOTTOMS.

The great expense and delay of docking a vessel for the purpose of cleaning its foul bottom has prompted inventors to devise other means whereby the removal of barnacles is effected more inexpensively and quickly. The most recent method of this kind forms the subject of a patent granted to Mason S. Moreno, Key West, Fla., and Hayden W. Branch, 404 Washington Street, Tampa, Fla.

In the system in question a scow is used, which carries the cleaning apparatus and which is moved along



A NEW WAY OF CLEANING SHIPS' BOTTOMS.

the vessel by means of side propellers. Adjustable side bars extend from the scow and carry buffers to prevent possible injury to the vessel. Rollers on the bars engage the side bars of a frame, on the lower end of which a brush or steel cleaner rocks. Swinging standards on the float each carry two rollers, between which the side bars of the brush frame move. The brush frame is yieldingly carried toward the hull of the vessel to be cleaned by means of weights attached to ropes running over pulleys and connected with the frame. The brush or steel cleaner is brought into engagement with the hull by means of lifting cables secured to the brush frame and to winding drums on the scow or dock. A drawing-down cable is fastened to the brush frame near its upper portion, passes down around the pulley on the lower end of a shifting bar, and up around second pulley to another winding drum.

The shifting bar referred to can be moved toward or from the vessel, as may be required; and can be adjusted vertically. The shifting bar is furthermore adjustably connected with the rocking bar, so that a swinging of the one will cause a like movement in the other.

When the brush is in its lowermost position, the drums are set in motion by the engine to wind up the lifting cables, thus drawing the brush up into contact with the hull. When the brush or cleaner reaches the surface of the water, the drawing-down cable is operated to pull the brush downward, the lifting cables being released from their drums. During this operation, the scow can be moved toward the side of the vessel by means of a stern propeller.

This apparatus can be carried (knocked down) on board a man-of-war, taking up less room than 60 cubic feet of space, and in a few moments set up on a dock in any part of the world, ready for cleaning the ship.

Death of Mrs. Roswell Smith.

Mrs. Roswell Smith, the widow of the publisher of The Century Magazine, died recently in New York at the age of seventy-two. When she was seventeen years old, as Annie G. Ellsworth, she sent the first telegraphic message — "What hath God wrought?" Her father was the first Commissioner of Patents, and has been called the "Father of the Patent Office." He was a close friend of Morse's, and together they induced Congress to appropriate $30,000 for the expense of a line between Washington and Baltimore. When the bill was finally passed, Annie Ellsworth carried the news to Prof. Morse, and he said she should have the honor of sending the first message, which she did.

A NOVEL REVERSING GEAR.

The reversing gear which is illustrated herewith is designed to permit the quick reversal of a shaft from a pulley continuously driven in one direction. The inventor of the device is Andrew Brott, of South Denver, Colorado. Fig. 1 is a sectional side elevation of one form of the invention. Fig. 2 is a sectional side elevation of a modified form of the gear.

In the form shown in Fig. 1 the shaft to be driven carries a loosely mounted support, provided with two bevel pinions engaging on either side two bevel gear-wheels likewise loosely mounted on the shaft. One of these gear-wheels is driven by a belt. Two clutches lock the respective gear-wheels to the shaft by means of cones connected by shifting arms, so that the operator can throw one clutch into engagement with its wheel and the other out of engagement with its wheel. A band-brake is controlled by the shifting-arms to brake the support of the bevel-pinions. The driven gear-wheel when locked to the shaft directly rotates the shaft in a forward direction by means of its clutch. The other gear-wheel being disconnected from the shaft, the pinions and the wheel in question evidently rotate loosely without transmitting motion to the shaft. To drive the shaft in the opposite direction, the operator moves the shifting-arms to apply the brake and hold the pinion support against rotation, to release the driven gear-wheel, and to clutch the other gear-wheel to the shaft. The motion of the driven gear-wheel is then transmitted by the pinions to the other gear-wheel, clutched to the shaft, but in a reverse direction from that previously given.

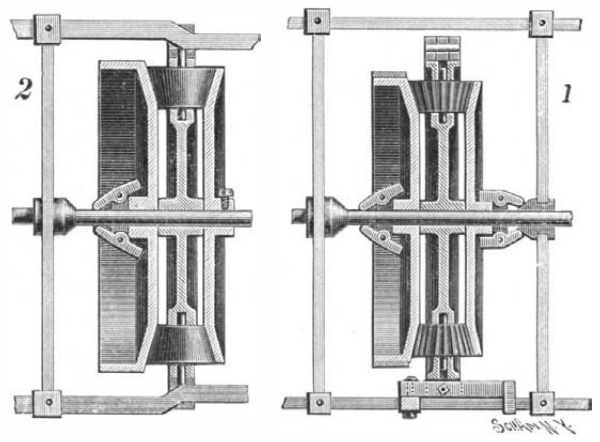
In the modified arrangement shown in Fig. 2, friction pinions and wheels are substituted for the bevel pinions and gears illustrated in Fig. 1; the loose driven wheel is provided with a clutch, but the other wheel is secured to the shaft by a set-screw. The brake is dispensed with, the support for the pinions being locked and released directly by the shifting-arms, which are given a special form for this purpose. The operation is essentially that of the form shown in Fig. 1.

The simplicity of the device and its efficiency constitute its chief advantages.

MAGNETIC CLUTCHES.

BY GEORGE A. DAMON.

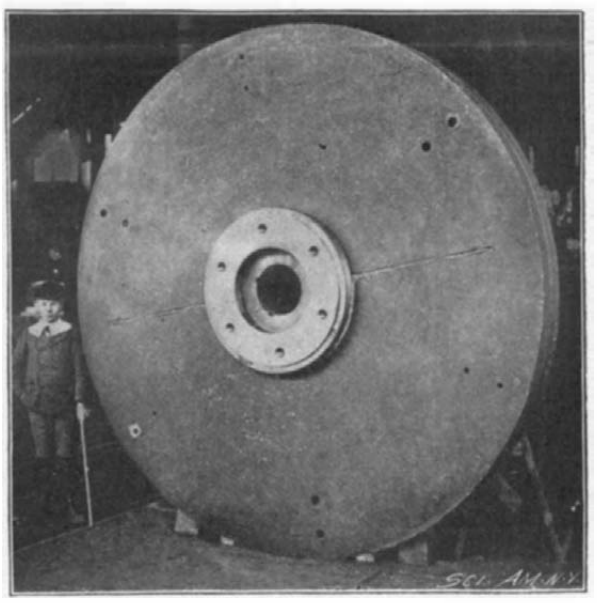
The magnetic clutch shown in the illustration is one hundred inches in diameter, and is capable of transmitting 3,000 horse power. It is the largest ever built, and is one of three recently completed to connect the engines and generators in a central electric power station. In designing power plants engineers have been limited to the use of the ordinary friction clutch, and its adoption for transmitting power has been so



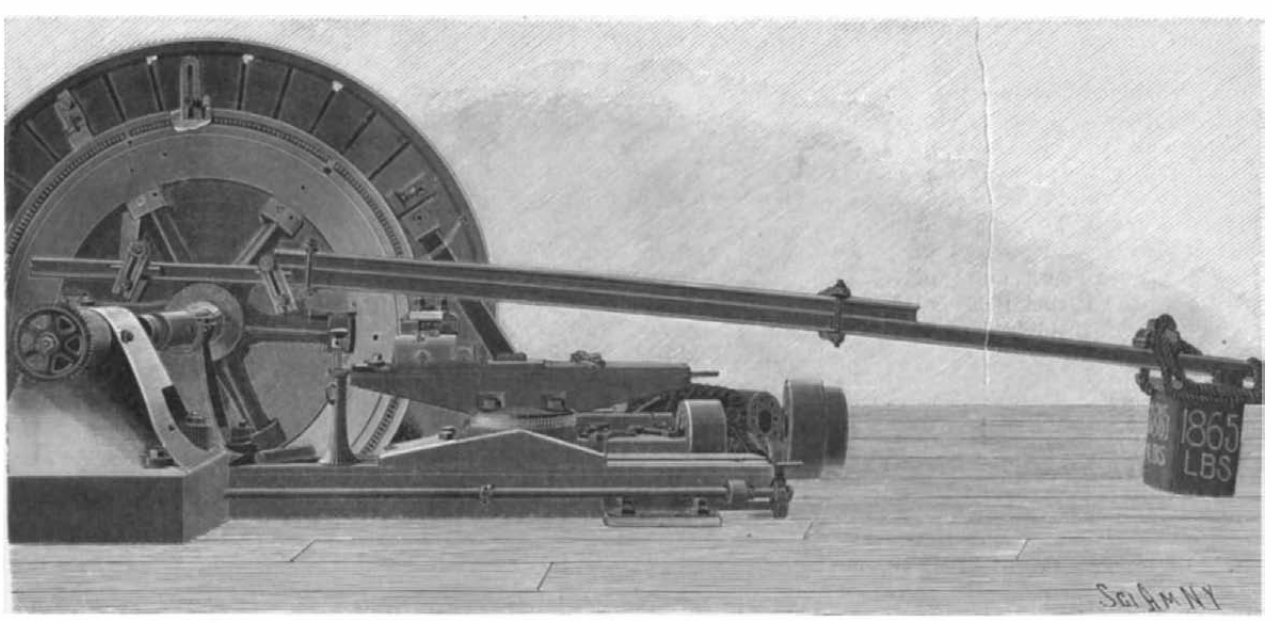
BROTT'S REVERSING GEAR.

universal that its action is well understood and its limitations recognized. The modern tendency toward large units, arranged compactly so as to occupy a minimum amount of floor space, has militated against the use of belts, shaft, pulleys and friction clutches, and it has become common practice either to connect the electric generators directly to their prime movers by means of a rigid coupling, or to key the generator armature upon the extended shaft of the engine or turbine. This practice is objectionable from lack of flexibility, and was developed because no coupling was found by which to connect or disconnect the generator readily that had the advantage of neat appearance and compact design. The magnetic clutch, therefore, possesses a peculiar interest as offering a solution to this problem.

Advantage is taken of the tractive force existing between two highly magnetized bodies of metal, and this action secures one of its chief points of advantage. The tractive power of any magnet depends upon the number of "lines of force" passing from the magnet proper to the armature which it is attracting, across the small air gap existing between the surfaces of the two parts. Owing to the superior permeability of iron it takes considerably less energy to maintain in it lines of force than is required to force them through the surrounding air, and, therefore, that magnet is most efficient which provides for its "lines of force" a closed ferric circuit of dimension sufficient to prevent oversaturation, and at the same time is designed to get the full benefit of concentration of magnetization at the contact surfaces. As such a magnet is self-contained, the adhesion is secured without any resulting external reaction, and a clutch built upon this principle will operate without the slightest end thrust upon its journals, and without requiring any applied mechanical force to put it into service. The power-transmitting capacity depends upon the coefficient of friction between the two surfaces held together by magnetic adhesion. An interesting test of this "torque" or turning power is shown in the illustration, in which a weight of nearly a ton is suspended on the end of a twenty-foot lever arm, the result being only to bend the rails of which the lever is composed without causing the clutch to slip. It might be added that only one of the two coils with which this clutch was provided was used in this test, and that the voltage applied to this one coil was reduced one-half before slipping occurred. The small amount of electrical energy required by an efficient magnet is quite as surprising as the large amount of tractive pow-



MAGNETIC CLUTCH CAPABLE OF TRANSMITTING 3,000 HORSE POWER.



TEST OF TURNING POWER OF MAGNETIC CLUTCH.

Length of lever, 20 feet; deadweight at end of lever, 1,865 pounds; energy necessary in exciting coils of clutch, 200 watts.

er developed, the large magnetic clutch shown requiring but 200 watts for its exciting coils, an amount of energy less than would be consumed by four 16-candle-power incandescent lamps. The efficiency of this clutch as a power-transmitting device is, therefore, 99·99 per cent, that is, the loss is one-hundredth of one per cent, which may properly be considered a negligible quantity.

In the application of the magnetic clutch in the central electric plant of the Imperial Company, of St. Louis, Mo., the clutches are used to connect the generator to the engines in such a way that each dynamo can be reached from more than one engine. The current is carried to the coils by means of collector rings attached to the sides of the clutches, and the electrical connections are simple and easily inspected. The collector rings take their current from insulated brush-holders, which are connected electrically to the source of current through a switch provided with a device for taking care of the inductive discharge when the oil circuit is broken. These switches are placed upon the switchboard, so that in starting or stopping a generator, all of the controlling devices are within the reach of one station attendant. The fact that magnetic clutches can be controlled by one or more push buttons or electric switches, placed at different parts of a room or plant, is one of their marked advantages.

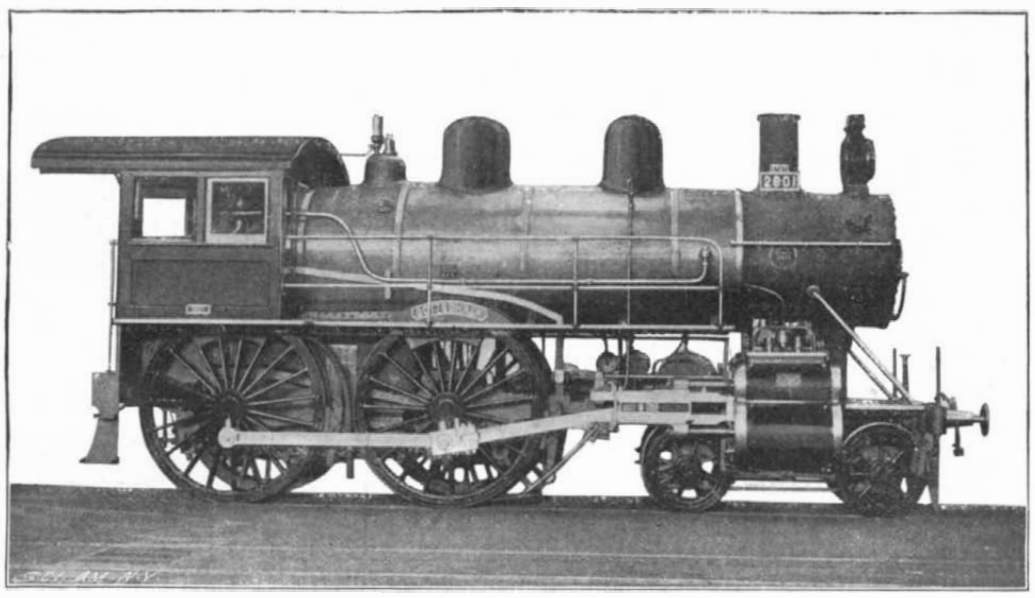
Mr. Bion J. Arnold, a consulting electrical engineer of Chicago, is the designer of this clutch, and he is now making extensive use of specially designed magnetic clutches for various purposes. A number are now being installed in a plant using large synchronous motors for driving heavy machine rolls, the main function of the clutch being to furnish a quick means of releasing the driving motor in case of emergency, thus allowing the rolls to be shut down without overcoming the inertia of the revolving motor armature.

The applications where the use of these clutches is desirable would seem to be limited only by the number of places where it is required to transmit power from one shaft to another. For motor applications to individual machine driving, for shafting transmission, for connecting generators to gas engines, steam engines, or turbines, and for any other purposes, the small amount of space required, the small amount of power needed, and the neat appearance of the magnetic clutch, will readily commend its use to engineers.

FENCES are easily grown in Cuba from pinon twigs, which are planted in rows a few inches apart.

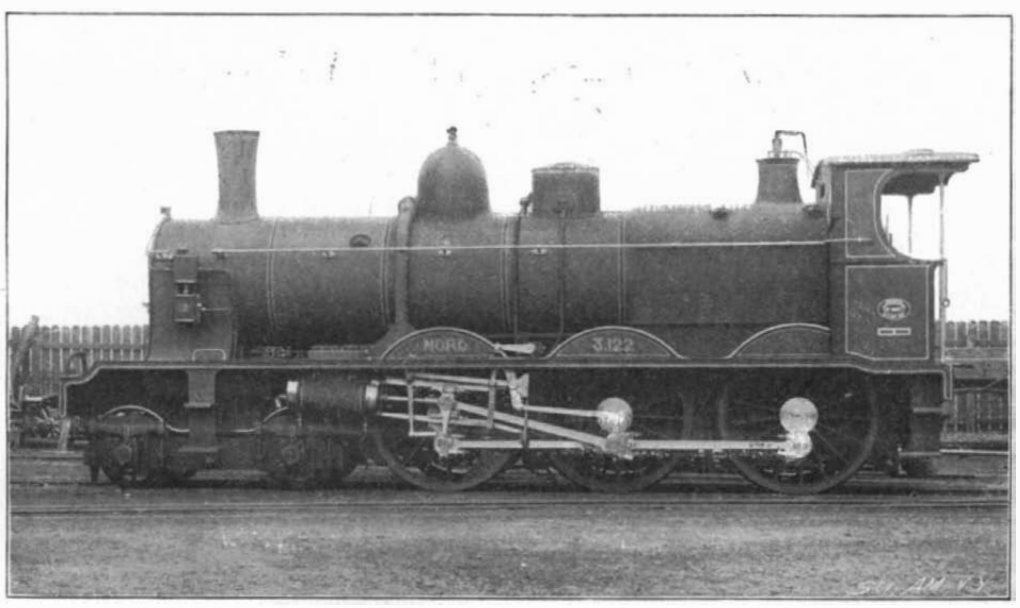
THE FOUR-CYLINDER COMPOUND LOCOMOTIVES OF THE NORTHERN RAILWAY OF FRANCE.

In a recent issue of the SCIENTIFIC AMERICAN, reference was made to the remarkable daily service of express trains run by the Northern Railway of France, which includes no less than forty-five trains, with an average timed running speed, including stops, of from 50 to 60 miles an hour. Of these forty-five trains, ten are timed to run at speeds of over 54 miles an hour. The present article will be devoted to a description of the four-cylinder, compound engines, which have been designed especially for this remarkable service. It is certainly difficult to find in the annals of railroading a parallel instance wherein a railroad company has made such a surprising advance in the number and speed of its express trains as has taken place on this French road in less than a decade; for it is a fact that ten years ago, the Northern Railway of France had no express trains on its schedule that were timed to run at a higher speed than 43 miles an hour, including stops.



1.—EIGHT-WHEEL, COMPOUND, AMERICAN EXPRESS LOCOMOTIVE, FOR THE FRENCH STATE RAILWAYS.

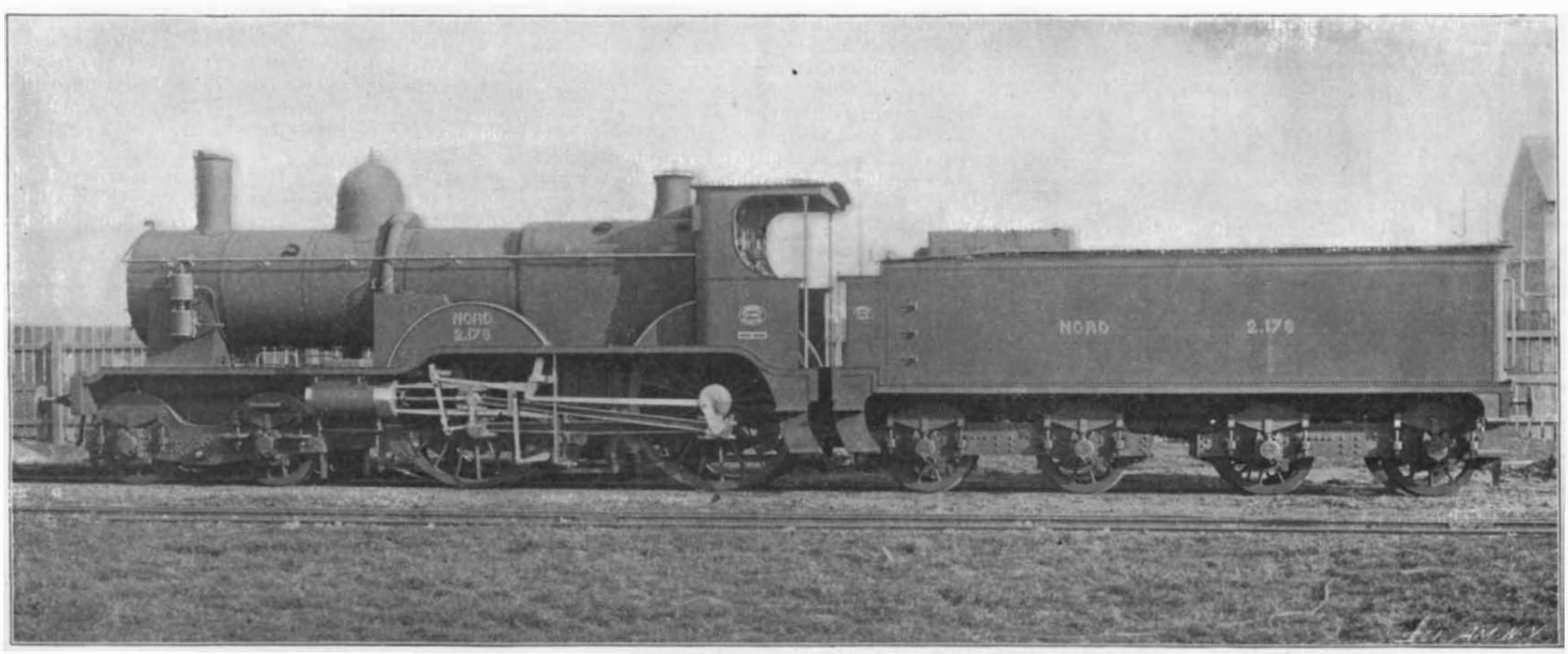
Cylinders, two H. P., 13 × 26 inches; two L. P., 22 × 26 inches. Drivers, 84¼ inches. Heating surface, 1,893 square feet. Steam pressure, 215 pounds. Weight of engine alone, 59 tons.



2.—TEN-WHEEL, COMPOUND, LOCOMOTIVE FOR HEAVY EXPRESS AND FREIGHT SERVICE.

Cylinders, two H. P., 13·8 × 25·2 inches; two L. P., 21·6 × 25·2 inches. Drivers, 68¾ inches. Heating surface, 1,950 square feet. Steam pressure, 215 pounds. Weight, engine, 65·6 tons; tender, 45 tons.

It was in the year 1885 that La Société Alsacienne de Constructions Mecaniques, under the superintendence of M. de Glehn, designed and built in its workshops at Belfort a four-cylinder compound locomotive for the express service of the Compagnie du Nord. That was, of course, before the era of the present fast express service, and the engine, which was no more powerful than the ordinary locomotives used by the company at that time, was built chiefly to prove that, owing to its economical steaming, the compound locomotive was sensibly more powerful than the ordinary type. When in 1890 it became necessary, on account of the increased weight and high speed of the new express service, to build a special type of locomotive, the excellent results obtained with the compound locomotive of 1885 induced the company to adopt the four-cylinder, compound system for its high-speed trains. An engine considerably more powerful than the compound of 1885 was designed, and with some minor modifications forms the standard express locomotive of to-day on this line. These engines, of which one of the latest type is shown in Fig. 3, conform in many respects to the standard eight-wheeled American engines, the likeness consisting in the fact that it has the truck and four-coupled drivers, and that the tender (a new departure in European practice) is carried upon two four-wheeled trucks. Apart from these broad resemblances, however, these fine engines possess marked characteristics of their own. They are of the four-cylinder, compound type, with the two high-pressure cylinders, 13·4 inches in diameter by 25·2 inches stroke, placed on the outside of the plate frames between the truck and the leading drivers and connected to the rear drivers, and the two low-pressure cylinders, which are 21·6 inches in diameter by 25·2 inches stroke, placed between the frames beneath the smokebox and coupled to the forward pair of drivers. The two pairs of drivers, which are 83¼ inches in diameter, are connected by the usual coupling rods, the arrangement being similar to that of the ordinary high-pressure locomotive of the Atlantic type in this country. The boiler carries a steam pressure of 215 pounds to the square inch. It is provided with Serve tubes, the heating surface of which amounts to 1,768 square feet, which with about



3.—EIGHT-WHEEL, COMPOUND, FRENCH LOCOMOTIVE, FOR FAST EXPRESS SERVICE.

Cylinders, two H. P., 13·4 × 25·2 inches; two L. P., 21·6 × 25·2 inches. Drivers, 83¼ inches. Heating surface, 1,900 square feet. Steam pressure, 215 pounds. Weight, engine, 56·5 tons; tender, 45 tons.

132 square feet in the firebox, making a total heating surface of 1,900 square feet. The weight of the engine loaded is 56·5 tons, and of the tender 45 tons, making a total loaded weight of engine and tender 101·5 tons.

The extreme length of the tender is one of the most striking features of these fine engines, the unusual size being evident even to American eyes, which are accustomed to tenders of liberal proportions. It is made of large dimensions to enable the trains to make long distance runs independently of the coal chute and the water tank. The capacity of the tender is 4,000 gallons of water and 5½ tons of coal.

Of the forty-five runs made by these trains, the fastest is that from Paris to Amiens, a distance of 81¾ miles, which is run in 1 hour and 21 minutes, at the rate of 60·5 miles per hour. The loads behind the tender vary from 150 to as high as 230 tons. In a recent trip from Paris to Amiens, when the load was 230 tons, a speed of 41 miles an hour was reached on an upgrade of 1 in 125, while a 4-mile stretch upgrade of 1 in 135 was climbed at a minimum speed of 50 miles an hour. The last 28 miles of the journey into Amiens was run under reduced steam in order to avoid a premature arrival, the train, as it was, reaching Amiens 2 minutes ahead of schedule time. Other remarkable timings are that of the express from Paris to St. Quentin, 95¾ miles, at the rate of 57·4 miles an hour; Amiens to Calais Pier, 104 miles, at the rate of 57·2 miles an hour; Longeau to Paris, 79 miles, at the rate of 56·4 miles an hour; and Amiens to Longeau, 31¼ miles, at the rate of 56·2 miles an hour. During a trip from Paris to Calais in stormy weather, when one of these engines was drawing a load of 19 coaches, weighing 280 tons, a rate of from 61 to 63 miles per hour, we are told, was maintained on the level in a heavy side wind; while on an upgrade of 1 in 125, the speed never fell below 41 miles an hour, and 75 miles an hour was recorded on a light down-grade.

a Perhaps the most remarkable feature of the work done by these compound expresses is the capacity to take a fairly heavy load up a grade with a constant acceleration. Reliable testimony as to the performance of the express trains is given by M. Rous-Marten, who has spent much of his time upon the footplates of express engines in Europe. On one occasion when he was present, the load being 128 tons, two miles from the start the speed rose to 60 miles an hour; at three miles it was 70 miles an hour, and at 4 miles from the start the train was running at 71·3 miles per hour. At this point it commenced to climb a 2½-mile grade of 1 in 200 on which the speed averaged for the whole distance 67 miles an hour. The speed was 68 miles an hour and was still rising when the summit was reached. The descent to Creil was made at the maximum speed permitted by law, namely, 77·5 miles an hour, and along the succeeding 50 miles of the road the average speed was 75 miles an hour. In a subsequent ascent of 10 miles, grade 1 in 133, the speed at starting, after a slowdown due to signals, was 40 miles an hour, and from that the acceleration was constant for the whole 10 miles, reaching 70 miles an hour at the summit, when it was still on the increase. Mr. Marten states that this uphill performance is without parallel in his experience. The run from Paris to St. Quentin, 95¾ miles, was made at the average speed of 67·4 miles an hour.

Our illustration No. 2 represents another type of engine which follows in some respects American practice. It was built from the design of M. de Glehn for the same railroad, and was intended primarily to run local trains, where quick starting and stopping is desirable, and also for hauling fast freight trains. Occasionally, however, these engines are used for the fast expresses, and they are used regularly on the heavier expresses, especially where the trains have to be taken over heavy grades. These engines have six wheels coupled, the outside, high-pressure cylinders being connected to the middle pair of drivers, and the inside, low-pressure cylinders to the forward pair. The high-pressure cylinders are 13·8 inches in diameter and the low-pressure cylinders are 21·6 inches in diameter, the piston stroke in each case being 25·2 inches. The driving wheels are 5 feet 8¾ inches in diameter. The boilers are particularly large for European engines, having a total of 1,950 square feet of heating surface, with 24·3 square feet of grate area, the boiler pressure being 215 pounds to the square inch. The weight of the engines loaded is 65·9 tons, and the weight of the tenders is 45 tons, the total weight of the engines being 110·6. The performance of the six-coupled engine is fully equal to that of the four-coupled type and indeed, if anything, it is superior. In a run from Paris to Lille a train made up of twenty-four coaches, and weighing altogether 382 tons, the locomotive put the following remarkable records to its credit. After starting 4 minutes and 14 seconds late, a speed of 53 miles an hour was obtained at the end of the third mile; 8 miles out from Paris the train, after being stopped by a signal at the foot of an up-grade of 1 in 200, attained a speed of 40½ miles an hour in the first two miles, the speed increasing steadily to 47 miles an hour, which was maintained to the top of the grade. On the down-grade the speed rose to 68½ miles per hour. Later, on 14 miles of an up-grade of 1 in 250, the load of 380 tons was hauled at a speed of from 48 to 51 miles an hour. The time of the whole run was 94 minutes and 34 seconds, the net time being 88 minutes and 40 seconds, and the average speed of 53·3 miles per hour for a distance of 78¾ miles. These performances, especially on the grades, are exceptionally creditable and speak volumes for the steaming qualities of these fine engines.

Our illustration, Fig. 1, will have special interest for our readers, for the reason that it represents the first American-built locomotive to be used on a French road. It has lately been built by the Baldwin Locomotive Works for the French state railways. In all its essential particulars it is of distinctively American type. Like the French engines we have above described, it is a four-cylinder compound, the system in this case being the well-known Vauclain type, in which the high-pressure cylinders are placed above the low-pressure, and connect to a common cross-head, the connecting-rod being coupled to the forward pair of driving wheels. The high-pressure cylinders are 13 inches, the low-pressure 22 inches in diameter, the diameter of the stroke being 26 inches. The valves are of the balanced piston type; the boiler is 58 inches in diameter and carries a working pressure of 215 pounds. The firebox, following the French custom, is of copper; there are 282 2-inch tubes, 12 feet 1 inch in length. The heating surface is divided as follows: Firebox, 128 square feet; tubes, 1,764 square feet; making a total of 1,892 square feet. The grate area is 25½ square feet. The driving wheels are 84½ inches in diameter, and the truck wheels 36 inches. The weight on the drivers is 34·9 tons, and the truck 24·1 tons, making a total weight for the engine of 59 tons. The tender is to be furnished by the company.

The chief points of difference between this engine and one built for an American road, it will be noticed, lie in the absence of the pilot and bell, and in the fact that the firebox is shorter, bringing the driving wheels closer together than would be customary in an American engine. It is to be regretted that this first locomotive built in America for a French road is not to be put in service on the Northern Railway of France, for it would then be possible to make some comparison of results between it and the celebrated compound locomotives of M. de Glehn.

New Practice in the Copyright of Photographs.

The following interesting article on the copyright of photographs, and the great hardship often inflicted through the severe penalty provided by the present law irrespective of the merits of the case, is republished from a recent issue of The New York Sun.

It has been a notorious fact for a long time that many photographic establishments have made a regular practice of levying a species of blackmail upon publishers, who have, unwittingly perhaps, published a copyrighted photograph without permission. It is not necessary that any damages should be proved, it being sufficient to establish the fact of the infringement. The penalty in many cases would amount to many thousands of dollars, while the photograph had, perhaps, no value whatever. The article says:

The law of copyright in its application to photographs is being interpreted through recent decisions of the Federal courts nearer to the evident intent with which it was enacted. The purpose of the law in declaring a property right in photographs was to enable a person photographed to retain control over his or her printed likeness and to prevent unauthorized use of it in publications or otherwise. The law had been turned so far from its original purpose that people rarely heard of a person photographed seeking its protection for his or her own sake, while attempts by photographers to mulct publishers who had used copyright photographs, often unwittingly, have been so frequent as almost to bring the law to scandal. The law's mandatory provision that for the infringement of the copyright $1 should be paid to the holder of the right for each reproduction of the photograph made it possible in the case of publications of large circulation for a litigious holder of a copyright to descend upon publishers with ruinous claims.

This was so well understood that many more cases of infringement were settled out of court than came to trial, so as to avoid the expense and annoyance of litigation and sometimes the high damages which the letter of the law ordered. In the case of a newspaper these damages would be punitive beyond the intent of the law makers. It has been testified to in court in this city that many of these outside settlements have been made. If a man or woman photographed had been injured, little objection would have been heard, but usually the effort was by a photographer to collect alleged damage to his business. In England, as in this country, litigation increased rapidly after the extension of the copyright law to cover photographs was made.

The work of reducing the exorbitant damages possible in collection for infringement of the law in regard to photographs was begun last month. The Supreme Court, in the case of Bolles against Outing, declared that the penalty specified in the statute could only be recovered "for each copy of the infringement which at the time of the announcement of the action was found by the photographer to be in the possession of the magazine and available for seizure, and that no penalties can be collected for such copies as had been previously distributed and sold."

This disposed of the opportunities to mulct publishers in $1 for each copy of a photograph used, which in the case of some publications would mean a handsome fortune for the plaintiff and ruin for the publisher, even if he had done no real damage and though the person photographed was neither injured nor offended. On December 14 another decision in a Federal court defined further the line of demarkation between injuries and privileges which the law intended to confer and the damages which photographers, who might under certain circumstances share in the law's benefits, have sought to show and in one way and another to recover penalties for. Suit was brought in Denver, in the United States Circuit Court, by the Detroit Photograph Company, of Detroit, to restrain Frank S. Thayer, bookseller, of Denver, from selling copies of a colored photograph of "The Palisades and Alpine Pass," made by W. H. Jackson in a publication sold by Mr. Thayer entitled "Colorado in Color and Song." The point was raised whether a man could claim a copyright in a photograph of natural scenery, even if he colored it himself. Judge Hallett ruled that "a photograph of natural scenery is not the subject of copyright, because it is not an original conception of the artist. It is merely a skillful manipulation of the camera. Further, it is not shown that there was any originality about the coloring of the photograph in question, and it was shown in the defense that the result achieved was old and in common practice."

Recently the question of the application of the Copyright law to photographs came up in the United States Circuit Court for this district before Judge Wallace and a jury. The Copyright League's counsel, Lewenson, Kohler & Schuttman, instituted a suit for $5,000 damages against Zucker, Levett & Loeb, who make a household preparation that has been advertised by a poster in which appears a woman's figure. It was contended that the figure was reproduced from a photograph of a chorus girl in a Broadway theater which had been made and copyrighted by Jacob Schloss. Schloss testified that he had made the photograph, that he had instructed the young woman how to pose to make the picture artistic and that he had then copyrighted the photograph. He brought one of the photographs to court.

The defense, represented by Simpson & Werner, said that an advertising poster design had been ordered by them from Gibbs & Williams, lithographers; that they had supposed the design original, and that they had ordered several thousand posters for use in cars. So soon as some of these had been put in the street cars a clerk of the prosecuting law firm, with a summons and a complaint, and accompanied by a United States marshal, called on the defendants, who were advised, one of them said, to settle the claim made for violation of the Copyright law. This suggestion the defendants decided not to comply with, not believing that they had violated the law, and holding that if it had been violated, the publishers of the posters, the lithographers, were the ones who had infringed the copyright. Their counsel contended that the photograph in question was not artistic and was not a proper subject for copyright. This issue Judge Wallace gave to the jury to determine as a matter of fact. The jury decided for the defendants. If the precedent set by this case stands, it may be found that the copyright on photographs of stage and platform celebrities is without value.

The United States marshal found 5,000 of the posters which it was alleged infringed the Schloss copyright in the possession of the defendants, and under the mandatory provision of the Copyright law this would have enabled the recovery of $5,000. Schloss testified on cross-examination that he had taken out copyright on many photographs of actresses, and that a number of suits for infringement had been instituted by him, most of which had been settled out of court.

Most of such claims in this country have rested, it is said, on a decision in a suit brought some years ago by the late Napoleon Sarony concerning a photograph of a British æsthete whose name attracts little attention now. The decision governing in England since copyright extended to photographs was given in 1888 in the case of Pollard against the Photograph Company. A few years ago The London Times published letters which showed the great number of claims made in that country after the enactment of the law creating a copyright in photographs. The recent decisions in this country would seem to indicate a diminution of such claims here in the future.

THERE is a vigorous protest being made against the new sewage farms near Paris. All of the local wells are infected, and there is an epidemic of intestinal troubles. The sewage seems to escape between fissures in the soil into subterranean sources of supply to the wells.

Science Notes.

The earthquake in the province of Tiflis has been very severe. Many villages have been destroyed, and the bodies of 800 villagers were found.

The Chief Commissioner for the Paris Exposition of 1900, M. Picard, is sanguine about the completion of the buildings at an early date. Many of the buildings are now ready for occupancy.

Prof. Kreutz, of Kiel Observatory, has telegraphed to the Harvard College Observatory that a comet was discovered by Giacobini, at Nice, January 31, in right ascension, 2 hours, 57 minutes, 44 seconds and declination —70° 55′.

The Egyptain government has appointed an Englishman as inspector of antiquities; Mr. Howard Carter was selected. He has been for many years identified with the Egyptian Exploration Fund. He will make an archæological survey of the Soudan.

We have been favored by a correspondent in Germany with a post card on which is printed a red strawberry. When the strawberry is exposed to heat, the color of the fruit blanches and disappears. It can be brought back to its original red color by blowing the moist breath upon it.

The annual exhibition and reception of the New York Academy of Sciences will be held at the American Museum of Natural History on the evenings of April 25 and 26. Specimens, apparatus, and collections illustrating the advances in science and researches during the year will be shown.

One of the most interesting features of the Paris Exposition will be the restoration of Pompeii. Not the familiar ruins, but the living city will be represented, and arrangements are being made to have the finest spectacular performance in the world, and the work is making remarkable progress.

According to A. Gautier, arsenic is constantly present in the thyroid gland, apparently like phosphorus and iodine, combined in the nucleins. Arsenic is also found in minute quantities in the spleen and in the skin, but no other organ gives even the faintest trace. This precise limitation of its occurrence has important toxicological significance.

The Secretary of the Interior has decided that the models in the United States Patent Office cannot be removed for the purpose of displaying them at the Paris Exposition. Commissioner Peck was desirous that an exhibit should be made, but it was decided that the models were records of the office and could not be removed under the law.

The pilot chart of the North Atlantic Ocean issued by the Hydrographic Office at Washington, for January, contains a chart showing the average track of 121 storms over the North Atlantic during the ten-year period 1889–98. The chart shows that the region of maximum storm frequency for that month lies to the north of the steamship routes in a belt extending northeast from Nova Scotia and Newfoundland across the Atlantic, says Nature. Some of these storms are the most severe, the largest in area, and the longest in duration, and may be traced clear across the ocean, while others disappear to the northward. The storms are divided into nine classes according to the regions in which they first appeared.

In Nature P. Q. Keegan describes a series of experiments with the object of deciding between the view of Berzelius that the original color of anthocyan is red and that of Wiesner that it is blue. His conclusion is, on the whole, favorable to the former hypothesis; but he believes that there are different stages in the development of the floral pigment. In the lower stages the natural color is red, whatever the chromogen may be; while in the higher stages the natural color of anthocyan is blue; or rather, at least with some chromogens, it becomes capable of forming blue compounds with alkalies and certain metallic acids. There also exist chromogens which, except under very exceptional conditions, are incapable of producing a blue pigment. These, in all stages, naturally develop into a red, the brilliancy of which unquestionably attests its real, original and proper character.

We have been favored by Mr. Duane Doty, Civil Engineer of the Pullman Company, with the annual statement relating to the operatives and wage earners at Pullman, Ill. A canvass of them shows that there are 7,152 persons employed in the various industries which are carried on at that place. 6,858 being males, and 294 females. Of the total 7,152, 1,544 are reported as renting homes in Pullman, 1,698 as boarding in Pullman, and 3,242 in all reside in Pullman. Nine hundred and fourteen own their homes, 1,599 own homes outside of Pullman, and 1,397 board outside of Pullman, or 3,910 neither reside nor board in Pullman. The average length of time these working people have been employed at Pullman is a little more than 6¼ years. The nativity of these 7,152 workers shows that there are 2,906 native-born Americans; 1,489 Scandinavians; 714 British; 817 Germans; 205 Russians; 146 from Belgium, France, Italy and Switzerland; 616 from Holland, and 259 from other countries.

Engineering Notes.

Two mining experts have gone to Erythrea in order to investigate the nature and extent of the gold-bearing reefs. The Italian government is hoping that operations on a considerable scale will prove profitable.

Some of the employes of the Pennsylvania who are past 70 years of age are unwilling to retire on a pension, says The Railroad Gazette, and one of these remonstrants is a baggageman on the New York and Chicago Limited who is 91 years old.

The German railway authorities are considering a proposal to abolish return trip tickets, holiday excursions and all special rates, says The Railway Review, thinking by this means they will be enabled to reduce the regular fares one-third with no resulting loss.

The Shelton Street Railway Company has settled the last of the claims for damages arising out of the terrible accident of August 6th, 1899, when 29 persons were killed and 12 injured. The terms of the settlements have not been made public, but are said to be considerable.

In all probability a steel plant will be established at the United States Arsenal at Watertown, Mass. The necessity of such a plant has been apparent for some time. The force of men are at present at work turning out the guns for the protection of Nantasket, Rocky Point, Baltimore and Galveston.

The total Russian petroleum production of the principal districts for the ten months amounted altogether to 7,882,447 tons compared with 8,355,310 tons for the corresponding period of 1898. Of this quantity, 6,646,972 tons were obtained by pumping and 1,235,574 tons were received from spouters.

It is a practice with ocean liners to save up their soiled linen, towels, etc., until port is reached, and passengers are obliged to do the same thing. Now, however, the steamship "New England" of the Dominion Line has been provided with a complete laundry for caring for the wash of the ship and that of the passengers as well. It is capable of handling 7,000 pieces of linen a day.

The last rails were laid on the Trans-Baikal section of the Siberian Railway on December 28, thus completing that part of the enterprise and establishing a communication between western Europe and St. Petersburg and the eastern limits of the Russian empire on the Pacific coast. The length of this section is 693 miles, says The Engineering and Mining Journal. The trains are transported across Lake Baikal on an ice-breaking ferry boat. The rail line is under construction from Sretensk, through Manchuria to Port Arthur.

The United States Bureau of Labor has been investigating the effect of displacement of hand labor by machinery in the iron and steel trade. It was found that in 1857 a rifle barrel took 98 hours to make by hand. It is now made in 3 hours and 40 minutes. Half-inch bolts 6 inches long with nuts were made by hand at the rate of 500 in 43 hours, while by machinery the same product is turned out with only 8 hours labor. In 1835, 100 feet of 4-inch lap-welded pipe required over 84 hours of labor, while in 1895 the same product was turned out in 5 hours.

Consul Graham, of Winnipeg, under date of December 23, 1899, writes: The Dominion Government has undertaken the improvement of St. Andrews Rapids in the Red River of the North, to facilitate the navigation of that river. These rapids obstruct the river about 18 miles from its outlet into Lake Winnipeg. They are about 8 miles in extent, and are the only serious obstruction to navigation between the international boundary and the lake. It is proposed to construct a system of dams and locks, with a lift of about 18 feet. The estimated cost of the work is $700,000 to $800,000. An appropriation of $150,000 has been made and is now available. The necessary surveying has been done and plans and specifications are now being prepared. A call for tenders for the construction will soon be made, and it is expected to have the work under way in the early spring. I trust that a number of American contractors will bid for the work.

We have already referred to the buffet car enterprise at Chicago; further particulars are now at hand. The cars will seat twenty persons, and the excess fare will be five cents. The crew consists of a conductor and porter, who will have charge of the small lunch counter and urns. Under this system, says The Street Railway Journal, a man may take his friends and customers to luncheon and show them the city at the same time. It will be very advantageous for the theatergoer who lives far out, and would like a supper after the performance ends. He may not wish to stay downtown and wait for the cooking of a supper, specially as he and his party may miss the last car. In the buffet car he will not only be getting what he wishes, but will be taking his party home at the same time, and will probably save the cost of a carriage and other expenses. The cars will be conducted as well as any transcontinental dining car.

Automobile News.

The Serpollet Company has constructed an artificial hill of 19 per cent grade on their property, on which to test their automobile vehicles.

The Berlin Electric Lighting Company is about to carry out some trials with automobile wagons for the conveyance of coal to their lighting stations, says The Motor Car Journal.

The electric cab and carriage service in Chicago has proved very successful. Notwithstanding the unfavorable conditions under which the company has labored as to stations, etc., the receipts have increased very largely.

The electric ambulance for St. Vincent's Hospital, New York city, is now completed and it is a most handsome vehicle. It is steered by the front wheels, with two 2-horse power motors driving it. Solid rubber tires are used and a rawhide gearing to lessen the noise of the machinery. The interior is lighted by a 10-candle power electric light.

The Street Car Men's Union of Cleveland, Ohio, are now building a large automobile stage, which is to be put in operation shortly on the Broadway route in Cleveland in competition with the Consolidated Company's cars, says The Street Railway Journal. The new carriage is 22½ feet long and resembles a street car. It has a seating capacity for thirty persons and is equipped with a 30 horse power gasoline engine.

It is said that fifty-five automobile wagons have been specially built in Paris for inland service in Africa, says The Western Electrician. They will be used in the Congo Free State to transport freight and passengers from the present terminus of a railroad at Badunbe to the upper and lower Niger. As the railroad construction advances, the automobile routes will be shortened, and after the completion of the railroad the wagons will be transferred to the other side of the Niger, which will be connected by automobile routes with important places in the rich western Soudan. It is said that the new transport service will be much cheaper than human porterage.

It is a curious fact that in France automobilists are obliged to make a declaration as to the quantity of hydrocarbon which they carry as fuel, at the gates of cities and towns, to the local customs officials of the "octroi," and The Motor Car Journal says that a service of motor omnibuses was about to be inaugurated between Sedan and Bourillon, the latter town being situated in Belgium. Although two-thirds of the projected route is on French territory, the French customs authorities demanded duty on the liquid hydrocarbon employed by the motor vehicles as fuel, and the promoters of the scheme preferred to abandon the scheme rather than comply with the extortionate order.

The Tailor and Cutter, of England, has considered the correct attire for automobilists and suggests the following: A double-breasted reefer, cut moderately easy-fitting in the body and fastened up to the throat, the neck being finished with a Prussian collar, the ends of which are placed under the top button, thus keeping it in place. Pockets are inserted in the fore part vertically, thus enabling the wearer to use them with greater ease than would be the case with the ordinary breast pocket. The material should be of herring-bone cheviot of some dark color, in order that it will not readily show dust or oil stains. The sleeves are finished with a tab, which can be fastened so as to bring them quite close to the wrists.

Juvenile Research.

Prof. H. E. Armstrong, F.R.S., described, in an interesting address before a conference of science teachers held at the Imperial Institute, the methods he had employed with his own children at home to educate them in the way of discovering for themselves the answers to questions which were presented in their daily life. The address was illustrated by practical demonstrations by Prof. Armstrong's little daughter and two sons, and a series of lantern slides made it quite clear how the system described had been developed. In reading a book by the late Henry Drummond, called "The Monkey that would not Kill," the children came across the statement that a stone weighs lighter in sea water than in air, and to satisfy them of the truth of the statement was the object of the piece of research which the children entered upon under the general supervision of their father. The steps in the inquiry were worked through again before a large audience, and the children themselves explained with remarkable intelligence what the object and result of these experiments were. Throughout the course of training, which was exemplified by the demonstration, each child kept a careful account of everything which was done, illustrating each step by means of sketches and recording every numerical result obtained. Prof. Armstrong maintained, says Nature, that the teaching of science to children was not commenced at an early enough date and that too little faith is shown by teachers in the reasoning faculties of young children.

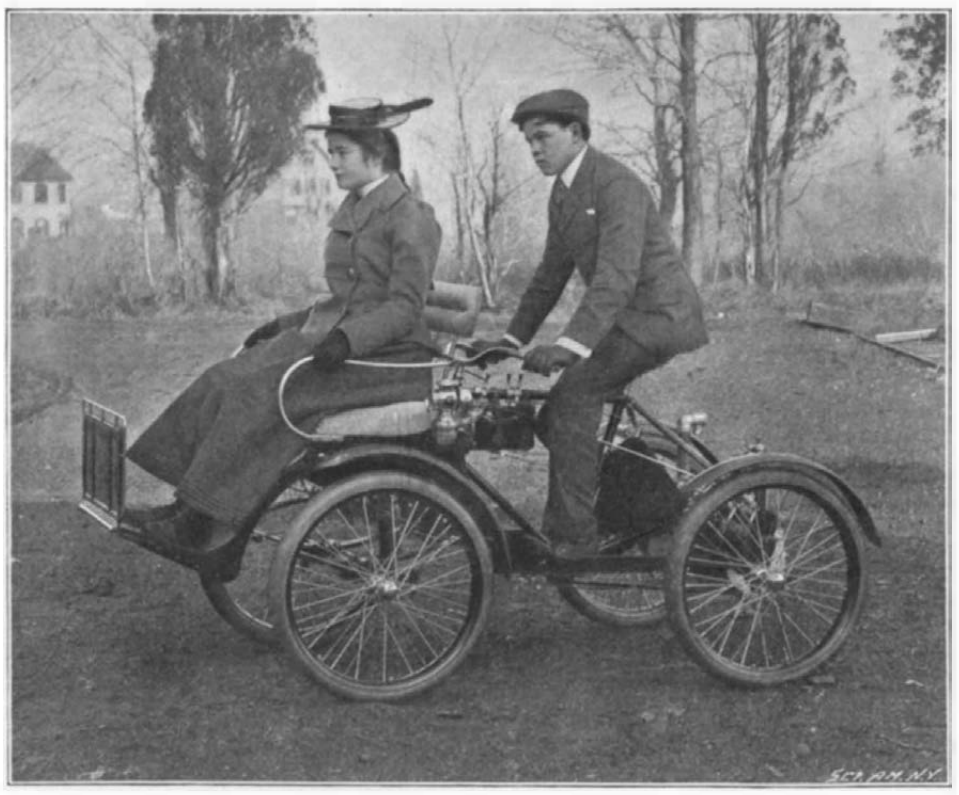
Models of the Navy Vessels.

The model shop of the United States navy is a part of the Bureau of Construction and Repair, and is under the direction of Rear-Admiral Hichborn. It is in the northwest corner of the house sheltering the marine railway in the Washington navy yard. Here are made exact reproductions of our war vessels from keel to truck and from stem to stern, only the models are, of course, on a very small scale. The workmen use the scale of a quarter of an inch to the foot, and the regular blue prints are used. The builder first lays the keel piece, then carves out another blank to make a horizontal section of the hull and glues it firmly above the keel piece, and by successive layers, each carrying approximately the shape of the hull for a new section, wood is added until the entire model is completed. The rough edges that remain after shaping and building up the hull are finished with knife, plane, and sandpaper before the paint is applied. Other model makers are engaged in making the tiny guns of different calibers, which are made of steel. The gun mounts are exact reduced copies of those actually in use on the war vessels. All the fittings are made with the utmost fidelity. The government possesses models of a large number of war vessels, says The New York Times, from which we glean our facts, and the larger ones are quite expensive, the "New York" and "Columbia" costing $7,000 and even the small ones cost $2,000, including the case. In all, something like $75,000 has been spent on models. It is considered, however, by the Navy Department that the money is well spent. The models are exhibited at various expositions which have been held throughout the country and have been seen by many thousands of visitors and doubtless many will never see the real warships. The completed models are to be seen ordinarily in the hall at the main entrance to the Navy Department at Washington, and in the hall above, just outside the door to the reception room of the Secretary of the Navy, and they are a never-failing source of interest to visitors. Several of them will be exhibited at the Paris Exposition.

AUTO-QUADRICYCLE AT THE BICYCLE AND AUTOMOBILE SHOW.

Continuing our notice of the display of automobiles at the recent Bicycle and Automobile Exhibition at the Madison Square Garden, New York, we now present illustrations of the auto-quadricycle, a four-wheeled vehicle which is arranged to carry two persons, tandem fashion, one in front on an upholstered seat of the kind commonly used in a buggy, and the other on a saddle, of the bicycle type, in the rear. It will be noticed that this compact little machine marks a transition stage between the bicycle and the automobile, retaining many features of the one and embodying the essential features of the other.

The framing of the auto-quadricycle is arranged in three fore and aft planes. The central frame, which carries the saddle, is of the standard diamond frame construction, except so far as the rear stays and forks are spread and additional stays inserted to accommodate the necessities of a four-wheel vehicle. On either side of the center frame is a light frame built up of angle iron and steel brackets. The whole is well braced together and forms a light but very strong construction. The machine is carried upon four 26-inch wheels of the common bicycle type with 2½-inch pneumatic tires. It is 7 feet 6 inches in length, 3 feet 6 inches in width. The motive power is supplied by a gasoline engine of the Otto type with a flange-cooled cylinder, which is mounted over the rear axle, and when running at economical speed develops 1¾ horse power. The band brake on the rear axle is controlled by a lever at the handle bar of the ordinary bicycle type. The speed may be controlled from five to twenty-five miles per hour. When it is complete, all ready for service, this machine weighs only 350 pounds. It was built at the factory of the Canda Manufacturing Company, Carteret, N. J.



AUTO-QUADRICYCLE EXHIBITED AT THE BICYCLE AND AUTOMOBILE SHOW.

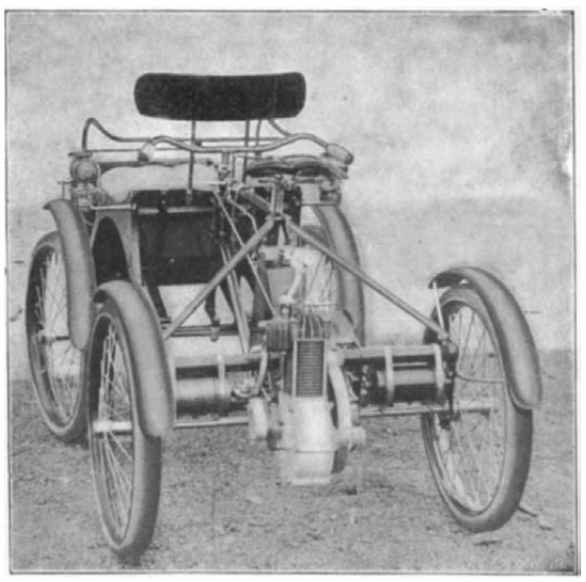
R. H. BIFFEN describes a fungus belonging to the Hypocreaceæ found on germinating cocoanuts, which has the property of breaking up the oil contained in the endosperm. The reproductive bodies observed were megaconids, microconids, pycnidiospores, and peritheces; but no ascospore could be discovered in the latter. The author attributes the property of splitting up oil to an enzyme, which can be obtained as a flocculent precipitate by the addition of an excess of absolute alcohol.—Annals of Botany, 1899, p. 363.

Old Fort Ancient.

BY W. G. IRWIN.

One of the many remarkable relics of prehistoric races to be found in the upper Ohio Valley is old Fort Ancient, in Warren County, Ohio. Grass-grown circumvallations, shaded by majestic trees moss-grown with age, and stray mounds containing broken pottery, fragments of bones, arrow heads, and buried altars where the sacrificial ashes still linger, mark the former home and final burying place of an unknown race.

The old fort is located close to the banks of the Little Miami and is surrounded by fully 5 miles of breastwork. This outer earthwork follows the irregular line of the hill, its greatest length north and south being about one mile, while its greatest breadth is probably half that distance. It is 10 to 20 feet in height and its thickness at the base is fully 75 feet. The outline is not unlike North and South America, and the fanciful theory that the mound builders designed to imitate the form of these continents has been advanced.



REAR VIEW OF QUADRICYCLE, SHOWING THE GASOLINE MOTOR.

At a point to the east, where there is no natural defense, there are parallel walls run out from the main embankment which extend nearly half a mile, the parallels being about 300 feet apart. At the eastern termini of these are two small mounds, which probably served as watch towers. In the entire wall there are seventy openings, some of which have been made by the action of the water, while others, it is almost certain, were used for exit and entrance to the fort. Trees which are over 200 years old are now growing from the walls, and much of the earthwork is covered with trees and bushes which will protect it for ages to come.

The fort is divided into three sections: the northern, which is called the New Fort, from indications that it was built last; the Middle Fort, which is narrow and had gateways and walls dividing in from the others, and is thought to have been designed as a citadel; and to the south the Old Fort. Opening into it from the Middle Fort is the Great Gateway, which is flanked on either side by a large mound. This central point is perhaps the most interesting of all. Bones, weapons, and other signs of human occupancy which have been found lying near the surface, indicate that a battle once raged at this point. In the Old Fort is a part known as the cemetery, where many stone graves have been located. When the earth is removed, the stones are found in regular order on the top of the grave, making a complete covering, and beneath the stones the skeletons are found buried in the earth. Weapons and pottery are also found in the graves.

The skeletons which have been exhumed in the fort, and nearer the surface, are supposed to be the remains of those who fell in battle; while a large number of human bones found on the west side of the hill under a pile of stones are supposed to be remains of enemies who were interred after the battle. The skulls that have been exhumed are of two classes, the long heads and the broad heads, which indicate either that two races have occupied the fort, or that its occupants were a mixed race. The arrow heads and spear heads are of several kinds of flint, red, white, black, and yellow. As flint is not found in the vicinity, the natives doubtless procured their supplies from other sections. A few pieces of quartz arrow heads as well as pieces of quartz have been picked up. Specimens of copper, hammered in the cold state, have here been discovered, as have perforated ceremonial slates. The pottery bears a resemblance to that found in the mound ruins of Western New York, rather than in those of Tennessee. Some of it is decorated with curved lines, some with dots, while some bear the marks of wicker-work.

There is but one natural spring within the walls of Fort Ancient, and there has been considerable speculation as to where the people obtained their water supply during times of siege. At several places there are indications that artificial reservoirs were constructed, and there are also traditions of a subterranean passage to the river. Within the inclosure there are many evidences of long occupation. Weapons of all shapes and sizes are found, and the flint flakes, the chips of their weapon making, are innumerable. The circles of lodges are discernible as depressions, and half a century ago these were more numerous. In the valley of the west are the remains of two villages, one above the other. From the older village at a depth of 5 feet the pottery obtained resembles that found in the fort; while that of the upper village, at a depth of 2 feet, is of ruder manufacture. Numerous graves as well as the ash-pits of these villages have been opened. Some of the skeletons are well preserved. Bones of animals and the antlers of deer have been dug up, and shells of the mollusks which flourish in the river on whose banks the village stood are found in the graves and in ash heaps, showing that they were used as ornaments, and that their contents were appreciated as food. The natives valued the pearls that these mussels produced, and there is a theory that the great heaps of shells at the mouth of the river were cast there by pearl hunters.

To the north and south part way down the Fort hill and on the hills opposite, are terraces 20 feet in width, which extend distances of several hundred feet. These, like the stone pavement which lies between the parallel walls, are a puzzle to antiquarians. They are the only specimens of pavement known to have been the work of the aborigines, and two suggestions have been made as to their purpose; one that it was used for games, the other that it was a place for sacrifices.

Thousands of relics have been already carried away from the Old Fort and its vicinity, and many good specimens can still be easily obtained. The Smithsonian Institution made a survey in 1892, and numerous relics were exhibited at the World's Fair. As early as 1820, the walls of the Fort had been opened; but there yet remains much to be done in the way of a complete study and exploration of this great work of prehistoric man.

The similarity of the weapons and of the mound indicates that one people inhabited the whole region. We may conclude that Fort Ancient was a citadel erected by a union of forces as a retreat in times of danger.

There are few Indian traditions which throw any light upon the history of these great pre-historic works. As to the age of the Fort, it has been asserted by some to be four thousand years old; but the weight of opinion is that one thousand will cover its existence. Meanwhile the walls of old Fort Ancient, the graves of the moundbuilders, their tools, implements, weapons, relics of their spoils and the ashes of their fires, are mute as to the origin or destiny of the race.

ALUMINIUM tubing used in the sciences is made so fine that 1,000 feet of it weighs but a single pound.

THE NEW INLAND WATERWAY.

BY J. A. STEWART.

Few people are fully aware of the magnitude and far-reaching consequences of the colossal enterprise in which the city of Chicago has been engaged for the disposition of its sewage. By the new sanitary canal, now practically completed, and quietly opened on January 20, the inter-ocean metropolis will not only have a more effective sewerage plant but also a better drinking water supply. Furthermore, the far-seeing project involves the institution of a new inland waterway by which vessels of the twentieth century may sail from the Gulf of Mexico through the Mississippi to the Great Lakes.

The accomplishment of this immense undertaking was rendered possible by the peculiar geography of the Great Lakes. Lakes Michigan and Huron are practically on the same level, about 580 feet above the sea, while Lake Erie is only about eight feet lower. Lake Superior is an independent basin twenty feet higher. The basin of the lower three of the lakes is so delicately poised, that only four feet of rocks and two of gravel at Chicago prevents them from spilling over into the Mississippi valley at high water. The rock bottom of the Niagara where it leaves Lake Erie, according to Prof. Wright, is only thirty feet lower than the rock-shelf which forms the barrier west of Chicago. The canal will turn a portion of the water of the Great Lakes along an old glacial outlet into the Mississippi valley. Thus Chicago engineers are at great expenditure doing something for which Nature herself had to all appearance previously arranged.

Under the general direction of the trustees, elected by popular suffrage, the work has been successfully prosecuted. The general plan of the great canal is to connect the south branch of the Chicago River with the Desplaines River at Lockport, Ill., whence it will flow to the Mississippi, a total distance of 34·05 miles. It is not a canal with locks to regulate the flow of water, but an open channel, which has greater cross section dimensions than any of the world's great shipways. Where it cuts through the rock it is 160 feet wide, and in the earth sections it slopes from 110 to 200 feet at the bottom to from 200 to 300 feet at the top—a channel sufficient to float the commerce of the vast empire of the West. The ultimate capacity of this channel is to be not less than 10,000 cubic feet per second when the lake is at Chicago datum (the low water of 1847), which is 4·7 feet below the high water of 1838 as established at Milwaukee. The law permitted the channel to be developed through the earth sections on the basis of a capacity of 5,000 cubic feet per second, provided that the same is enlarged with the growth of population to the ultimate capacity of 10,000 cubic feet per second, which is sufficient in the view of the law to so dilute the sewage of 3,000,000 people as to maintain a sanitary condition throughout the channel and in the streams into which it is to discharge—the Desplaines and Illinois Rivers.

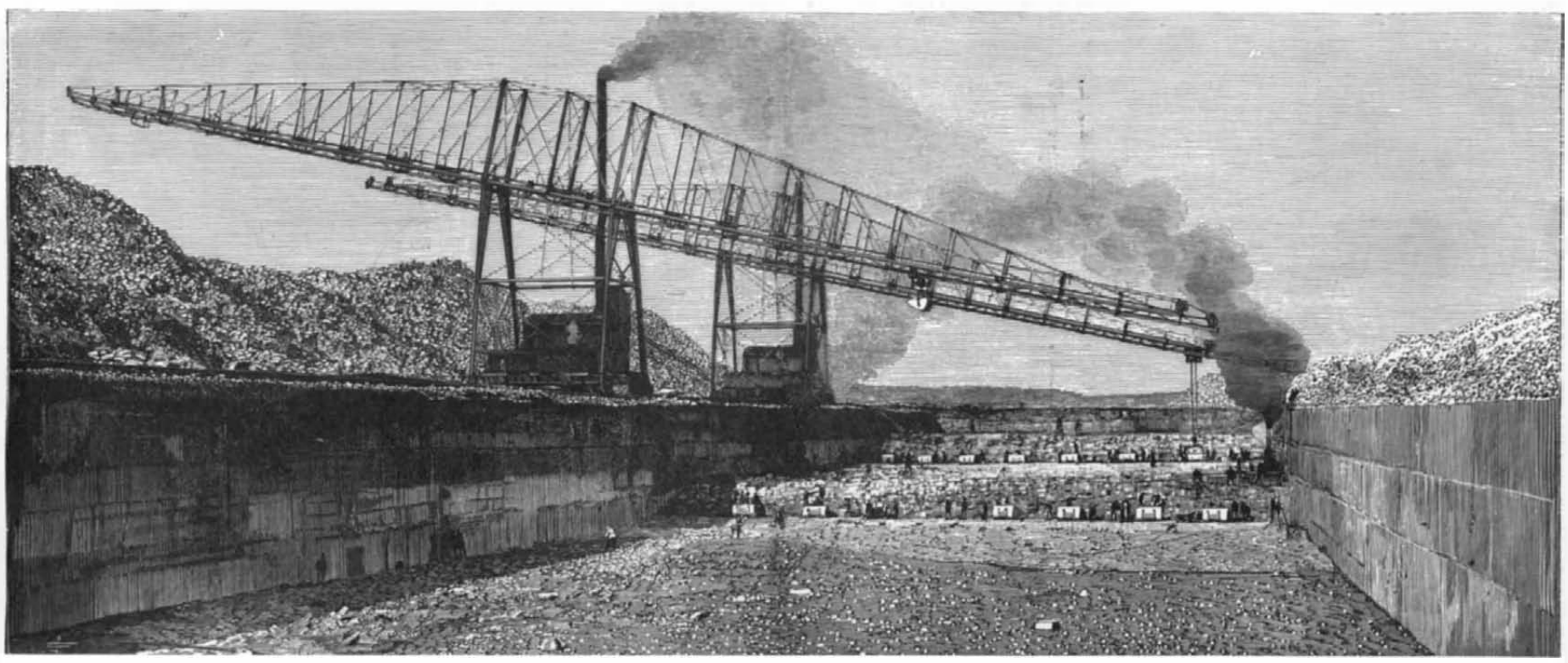
The work in the Chicago River has involved, first, dredging from the lake to Roby Street to a uniform depth (except over tunnels) of twenty feet below the flow line. Second, constructing between Monroe and Van Buren Streets a covered conduit or bypass through the lands of the Pennsylvania and Alton Railroad companies. This bypass has a section for flow of water fifty feet wide and sixteen feet deep. Third, removing two center pier bridges, one at Taylor Street and the other the railroad bridge just south of it, and building in their places bascule bridges of the rolling lift type. At Canal Street a bascule bridge is substituted for the "jack-knife" bridge. The river has been widened and redocked at various places. The result of these improvements is adequate provision for a flow of 300,000 cubic feet per minute.

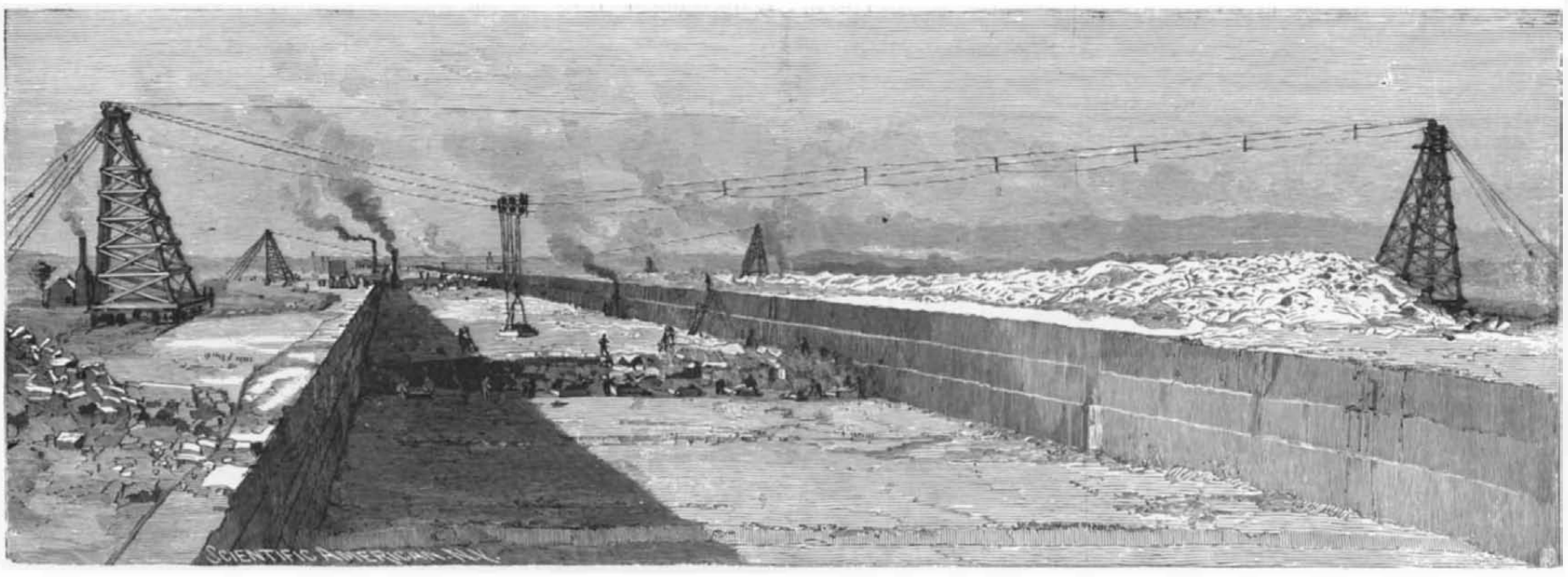
The distance from the mouth of the Chicago River to the junction of the main channel with the west fork of the south branch at Roby Street is 5·8 miles. The main channel begins at this point in the southwest quarter of the city and extends to the controlling works at Lockport, a distance of 28·05 miles. Beyond these works the water is to be discharged into the Desplaines River, down the declivity to and through the city of Joliet, a distance of 7·1 miles.

Earth was first broken on "Shovel Day," September 3, 1892, on the rock cut below Lemont. For 7·8 miles out from Chicago, the channel was constructed with a present capacity of 300,000 cubic feet per minute, the future enlargement being simply a matter of dredging through comparatively easy material. The 21 miles in the Desplaines valley is through glacial drift of the most difficult character and through rock, and this part of the work was carried out on the ultimate basis of capacity. The standard dimensions adopted were for 14·9 miles through the rock cut 160 feet wide at bottom and 162 feet at top with a grade of one foot in 20,000 feet, and in the earth and drift for a distance of 13·15 miles, 202 feet at bottom and 290 feet at the water line when the channel is carrying 22 feet of water, with a declivity of one foot in 40,000 feet, excepting, however, the 7·8 miles at the Chicago end previously mentioned, which were constructed with a width of 92 feet less than the standard earth section.

In order to accomplish the work, the upper Desplaines River, a stream of wide fluctuations and no reliable fountain supply, was given a new course and practically lifted out of its old bed, which was then used for the canal. This bit of engineering involved the construction of about thirteen miles of new river channel (the "river diversion" channel) and about nineteen miles of levee built to control the water of the Desplaines watershed. At the head of this river diversion it was necessary to provide a safety valve in the form of a spillway to allow surplus waters an outlet. This spillway is a concrete dam, 397 feet long, capped without stone, and its wings faced with stone masonry. No water flows over it until the volume passing the water gage above it reaches 300,000 cubic feet per minute. Its crest is 16·25 feet above Chicago datum.

The southern end of the main drainage channel at Lockport is enlarged so as to form a "windage basin" in which large vessels may be turned around. Here also are located the controlling works of gates or movable dams, by which the flow of water from the main channel into the tail race, which is to deliver the outflow into the lower Desplaines River, can be regu-





Cantilever Cranes and Hoisting and Conveying Cables at Work on Rock Cuts.

THE CHICAGO DRAINAGE CANAL IN COURSE OF CONSTRUCTION.

lated. At the controlling works provision had been made to meet the fluctuations in Lake Michigan within a range of five feet above datum and eight feet below, or an extreme oscillation of 13 feet. The fall from datum at the controlling works to the level of the upper basin is about 42 feet, in a distance of about four and one-third miles.

Seven sluice gates of metal, with the necessary masonry bulkheads and one beartrap dam, comprise the controlling works. The gates are the modified Stoney gate type, having a vertical play of 20 feet and openings of 30 feet each. The beartrap dam has an opening of 160 feet and an oscillation of 17 feet vertically. This dam is essentially two great metal leaves hinged together and working between masonry bulkheads. The downstream leaf is securely hinged to a very heavy foundation, and the upstream leaf is so placed as to present the barrier to the water. In operation, water is admitted through conduits controlled by valves beneath the two leaves. To raise the crest of the dam, water is admitted from the upstream side and the discharge shut off until the desired height is obtained, and then the valves are adjusted so that the volume of water beneath the leaves shall be constant. To lower the crest, the water beneath the leaves is drawn off until the desired height is reached, when the valves are again arranged to maintain a constant volume of water.

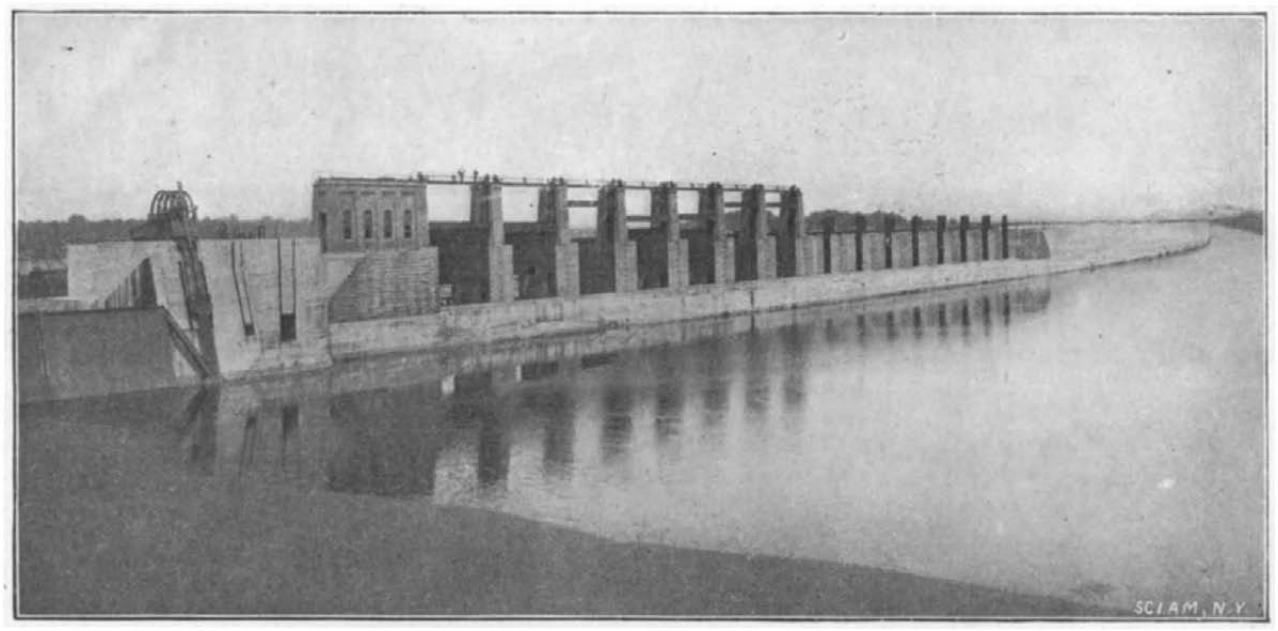
The lower Desplaines River below Lockport follows the trough of the valley down a steep declivity to the Illinois and Michigan Canal basin in Joliet. The work in this position consisted of straightening, widening and deepening the river to give it a flowage capacity of 1,500,000 cubic feet of water per minute. This involved, in the city of Joliet, the rebuilding of certain dams and locks and the removal of others in the canal; the construction of a massive concrete wall to separate the canal from the river; a great deal of costly excavation to admit of an extensive water power development which is the property of the State; and the substitution for smaller bridges of new ones of modern steel and greater span and width.

It is a noteworthy fact that all the bridges on the main drainage channel are movable structures. There are six for public highways and seven railroad bridges. The bridges on the walled and solid rock sections of the work are all "bobtailed," (or have arms of unequal length) counterweighted structures, with first piers on the right bank, and long arms spanning the entire channel, thus avoiding any obstruction to the flow from center and protection piers. These bridges are of the latest design, conforming to the heaviest modern specifications.

The total amount of excavation presents an interesting feature. The grand total reaches 43,478,659 cubic yards for both the drainage channel and the river diversion. The whole volume of the earth and rock excavated, it is claimed, if deposited in Lake Michigan in forty feet of water, would make an island one mile square, with its surface twelve feet above waterline.

For the method of work, various well-known devices were utilized, though no established precedent was followed. Some original methods were introduced by ingenious contractors. On certain earth sections, cars, especially constructed, were loaded by steam shovels and drawn up by steam hoists to a proper height where they ran on to a tipple and were automatically dumped. On other sections the contractors erected bridges spanning the banks, their supporting piers being carried on trucks which traveled on tracks parallel with the channel. An inclined track ran down from the bridge into the cut, up which were drawn the cars by steam hoists, after being loaded by steam shovels, to be automatically dumped and then returned to the pit. Hydraulic dredges were economically and effectively used on the old channel of the upper Desplaines, which was overlaid with muck to a considerable depth. The sides on the rock sections were cut down vertically by channel machines, steam drills being used which were worked by compressed air from a central power station. The top lifts were removed by the use of carts and tram cars, supplied with traction by steam hoisting engines. The lower lifts were removed by cable-ways, high power derricks and cantilever conveyers, the last proving the most perfect device for the purpose of hoisting and disposing of material, although the cableways did excellent service. The cantilever conveyer used was practically a bridge spanning the channel with cantilever arms projecting over the cut on each side. On this were mounted the necessary sprocket wheels and other machinery for carrying a series of steel pans which form the conveyer belt. The structure was 640 feet from end to end, and it was mounted on trucks traveling upon tracks parallel with the channel. Its capacity was 500 cubic yards per hour.

Financially, the realization of their sanitary device has involved a large expenditure for the people of Chicago. There has been expended to date on the construction $23,693,014.20, one million of which was for the river diversion, one-quarter of a million for the controlling works, and two and a half millions for bridges. In addition the right of way has cost over three millions; administration, more than two millions; and maintenance nearly one hundred thousand, making a total outlay, inclusive of three and a half millions for interest charges, of $33,525,691.20 to January 1, 1900.



CONTROLLING WORKS AT LOCKPORT, ILLINOIS.

Silicide and Bisulphide of Molybdenum.

The preparation of silicide of molybdenum has been the subject of a number of experiments made by M. Vigoroux, who has given an account of his results to the Academie des Sciences. M. Moissan had already shown that the molybdenum produced in his electric furnace combined directly with silicon. The experimenter continues the study of this combination. To produce it he takes the product obtained by the calcination of molybdate of ammonium, which is a mass containing variable proportions of the two oxides, Mo O_3 and Mo O_2; this is mixed with crystallized silicon. Thus, to 100 grammes silicon are added 250 grammes of the oxides, and the whole is heated in a carbon crucible introduced into the electric furnace, which works at a current of 1,000 amperes and 50 volts. During the heating the molybdenum liberated combines with the silicon, the larger part of the slag is volatilized, and after cooling there remains a mass which has a metallic appearance, its fracture indicating an abundance of crystals. These are separated by subjecting the mass to electrolytic action, it being used as the anode in a bath of dilute hydrochloric acid, the cathode being a plate of carbon. A weak current detaches the crystals, which fall to the bottom of the vessel. After treating alternately with aqua regia and potassium hydrate, the crystals are subjected to the action of hydrofluoric acid, then washed and dried. These crystals contain the silicides of molybdenum, iron and carbon. By means of tungstate of cadmium the silicide of carbon is removed, but it was not until after many trials that a product was obtained which was free from iron. The silicide of molybdenum thus obtained corresponds to the formula $Si_3 Mo_2$. Its properties are analogous to those of the silicide of tungsten previously obtained by the same experimenter. Thus, in chlorine gas it burns with incandescence near 300° C., forming tetrachloride of silicon and a black perchloride of molybdenum, which is deposited upon the glass.

Another preparation of molybdenum has been studied by M. Marcel Guichard, the bisulphide, which has not been previously obtained in any considerable quantity. After numerous experiments, two forms of the bisulphide were obtained, the crystalline and the amorphous. As to the crystalline form, Dr. Schelten, in 1889, obtained small quantities of microscopic crystals by melting carbonate of potassium with sulphur, and adding by degrees molybdic anhydride. Starting from this synthesis, the following process was employed: A mixture is made of 150 grammes carbonate of potassium, 310 grammes sulphur, and 200 grammes bioxide of molybdenum. This mixture is heated for half an hour to the maximum temperature of a Perrot gas furnace. After cooling, the mass, consisting of polysulphide and sulphomolybdate of potassium and bisulphide of molybdenum, is treated with water, which leaves undissolved the crystals of the bisulphide; the experimenter has thus obtained as much as 80 grammes. If for the bioxide of molybdenum is substituted molybdate of ammonia, the quantity obtained is less, but the sulphide is well crystallized, and specimens of one millimeter length, of hexagonal form, were found; these are of a grayish-blue color, resembling that of natural molybdenite. The amorphous form of the sulphide has been obtained by Scheele by the action of sulphur upon molybdic anhydride at a high temperature.

The experimenter has obtained a considerable quantity by the following process: With 50 grammes of crystallized molybdate of ammonium, finely powdered, are mixed 100 grammes sulphur, and the mixture is well packed into an earthen crucible, which is covered, and placed in a larger crucible, the interval being filled with lampblack. A white heat is maintained for one hour in the gas furnace. The sulphide thus produced contains still a small quantity of oxygen, as analysis shows. It is again mixed with its weight of sulphur, and re-heated as before. The bisulphide is thus obtained in a pure state, and it appears as a gray powder, the whole of the molybdenum having been transformed. As to its chemical properties, it is not acted upon by sulphur in the form of solution in chloride of sulphur in a sealed tube, and phosphorus is equally without action upon it. The experimenter has tried to obtain a sub-sulphide by a gradual reduction of the bisulphide by hydrogen, but finds that the reduction takes place with production of the metal, without passing by the sub-sulphide. It has been shown that natural molybdenite, which is a bisulphide nearly pure, loses its sulphur at the temperature of the electric arc, giving the metal. In studying this action upon the bisulphide, the experimenter finds that a new product, the sesquisulphide, is formed; this he intends to make the subject of a future communication.

Experiments of M. Becquerel.

M. E. Becquerel has presented at the last meeting of the Academie des Sciences an account of a new series of experiments which he has made upon the action of radio-active matter in a magnetic field. In the experiments previously described, the active matter contained a large proportion of the newly discovered element radium; in continuing his experiments with matter containing the other new element, polonium, discovered by M. and Madame Curie, which possesses properties analogous to the former, he finds that the action is entirely different; the radiations from this body, while showing in other respects nearly the same activity as those of radium, are not appreciably affected by the magnetic field. M. Becquerel shows this conclusively in the following experiment. The preparation of polonium is placed between the poles of an electro-magnet whose intensity equals 4,000, then 10,000 c. g. s. units; above this, at distances varying from 2 to 10 millimeters, a photographic plate was disposed horizontally. This plate was not enveloped in black paper, as in the case of radium, as the rays from this body are absorbed to a considerable degree; the operation was therefore carried out in the dark. Under these conditions, after some minutes' exposure an impression is obtained upon the plate which is symmetrical with relation to the radiant source, and this impression is the same, whether the magnet is excited or not. If the preparation of radium is then substituted under the same conditions, an impression is obtained upon the plate which, under the influence of the magnetic field, is thrown over to one side as in the previous experiments. It thus appears that the radiations emitted by polonium are not influenced in the same manner as those of radium. It has been observed also that these rays are very unequally absorbed by different substances. To these observations should be added those made by M. and Mme. Curie upon the compounds of uranium, which are found to be unaffected by the magnetic field.

At a recent congress of Russian railway officials, it was decided, says The Railway Review, that there should be erected at various places hospital stations and baths, and that in some regions bathing cars should be run, as is now done along the Siberian Railway.

CURIOSITIES OF ICHTHYOLOGY.

BY CHARLES MINOR BLACKFORD, JR., M.D.

The study of ichthyology is attended with greater practical difficulties than is that of any other branch of natural history, and on account of this it is far behind its sister sciences in the degree of completeness to which it has attained. Land animals may be tracked to their most secret lairs, patient research will reveal the most cunningly hidden nests, but it is impossible to pass beneath the waves to watch the habits of "all that dwell therein." "The way of a fish in the sea" is almost as much a mystery now as in the days of Solomon, and what is known but shows the extent of the unknown.

Suppose that a visitor from some other planet were to come on an exploring expedition to our earth, but that his vessel could come no nearer than several miles, while our atmosphere was opaque to his vision and unfitted for his respiration. Under such circumstances his position would be not unlike our own in regard to the sea, and it may be perceived that in either case the knowledge to be gained must be scant and fragmentary. The astral explorer might capture a few of the lowest animals in his nets and dredges; he would probably obtain some worms, but he would be unlikely to take a bird, quadruped, man or any other thing that has the power of locomotion. For the same reasons the investigation of the sea has been slow and unsatisfactory, and but little has been made out of even the commonest fishes. Many species and some genera are known by single specimens, and in several instances these have been found by what appears to be the purest chance.

Quite a number of rare specimens have been obtained from the stomachs of other aquatic animals. The greater number of fishes are carnivorous and most of them are voracious feeders, greedily swallowing anything of a suitable size that presents itself. A shark's stomach sometimes contains a remarkable assortment of objects, and sometimes rarities are discovered, for sharks are more intent on the quantity than the quality of their food. There is a genus of fish called the Tarletonbeanea, in honor of Dr. Tarleton H. Bean, a distinguished ichthyologist, but of it only three specimens are known to exist. Of these, one was taken from the stomach of an Albacon off the coast of California, one came from a Sebastodes miniatus, and the third was blown on board of a boat during a storm.

A still stranger example is that of the "seal fish." In making some investigations into the life of the fur seal a few years ago, it was necessary to determine the character of the food on which it subsists. To do this, the stomachs of numbers of seals were opened and their contents examined, and in them the remains of a new kind of fish was found to be very common. Nothing but the bones (Fig. 1) have been found, but these in such numbers as to show that there must be vast quantities of these little fish, although up to the present time no one has seen a single one in life.

The existence of a small fish in the sea is beset with dangers. From the time the eggs are deposited until the moment of its death, it is surrounded by enemies seeking to devour it, and it is forced to find some shelter or die. One little fellow takes refuge under the "Portuguese man-of-war," and swims in safety between the poison curtains, knowing well that the most ravenous foe will not molest this formidable sea nettle. At times, it is said, he pays for his shelter with his life, but such cases are probably rare. The large medusæ, or jelly fishes, found in tropical waters, often cover a shoal of small fry that live in peace amid the poisonous tenacles that keep enemies aloof. In case the medusa seizes an occasional victim, it is but just, for every good citizen should be willing to suffer for the power that protects him, and the defenseless fishes stand in relation to the medusa as did feudal retainers to the lord whose name and fame gave safety.

Living near a protector is a far different matter from living inside of one, but several fishes are known that take up their abode in the interior of some larger animal. The holothurians or sea-cucumbers have long been known to shelter a small fish, to which Cuvier gave the name of Fierasfer. This fish seems to live in rather deep water, for holothurians found close inshore are free from it, while it is very common in those from certain depths. When free the fierasfer swims with its head downward and its tail curved toward its back. It is a feeble swimmer, and is speedily drowned when put into a tank with other fishes, for it can neither escape, fight nor hide, except in its own peculiar lodging-place. When it sees a holothurian, it seems to get excited. It comes up to the opening by which the holothurian sucks in and expels the water necessary for its existence and gradually backs in, taking advantage of the suction and bracing itself against the outward flow, until it is entirely inclosed. Prof. Emory, who studied the fierasfer in Naples, says that it often protrudes its head in search of food, and does not live on its host or the food taken in by the holothurian. It is not a parasite, but a lodger. Several such tenants occupy the same host together, and may inflict fatal injuries, but this is accidental and probably rare.

The sea is the great home of aquatic life, but the fresh waters well repay research. The "lung fishes," that can breathe atmospheric air, and thus avoid polluted waters, or the mud fishes, that are captured by digging them up, are interesting variations from the general rule, but the subterranean species are most wonderful. The blind fishes found in our great limestone caverns and those from the ditches of the ricefields are familiar, but the secrets of "the waters under the earth" are not yet made plain. A few years since, a station was established by the United States Fish Commission at San Marcos, Texas. An artesian well was bored, and a flow of 1,200 gallons of water per minute obtained at a depth of 188 feet. The boring was through almost solid limestone, the "log" of the well showing that one tunnel some two feet in diameter was pierced, but the flow has brought up numbers of living organisms, all new to science. So far four species of shrimps and a salamander have been described, but these have been abundant. Dr. James E. Benedict, of the Smithsonian Institution, described and named the shrimps, and Dr. L. Stejneger, of the same establishment, did the same for the salamander. He gave it the name of Typhlomolge Rathbuni, in honor of Mr. Richard Rathbun, the assistant secretary of the Smithsonian Institution.

The accompanying illustration gives an accurate conception of this strange animal. Its head is large and prolonged forward into a flattened snout in which is the mouth. The eyes are covered by the skin and are visible only as two black specks. Behind the head the external gills form festoons about the neck, their vivid scarlet making a sharp contrast with the dingy white skin. The four legs are in two pairs, the anterior ones having four fingers or toes and the posterior ones having five. It terminates in a flattened, eel-like tail.

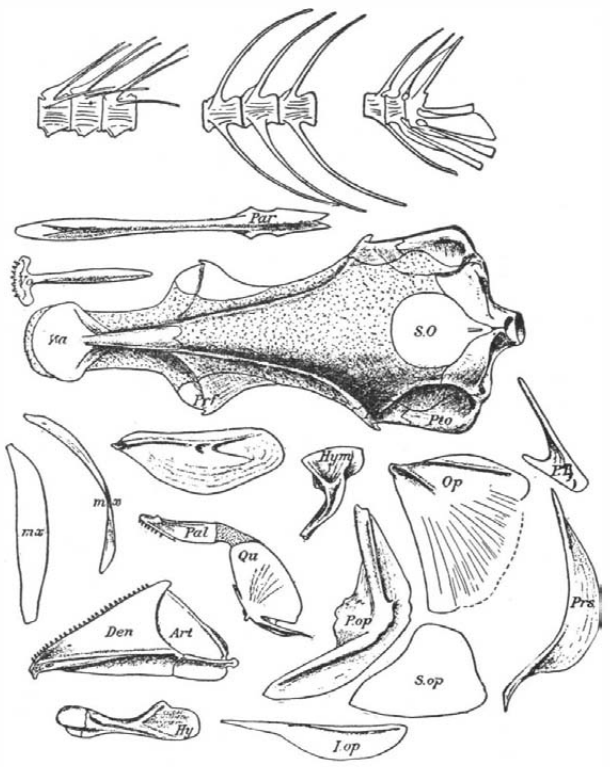


Fig. 1.—BONES OF A "SEAL FISH."
(Thelobromus callorhini.)
Drawn by L. A. Lucas, from specimens found in stomach of fur seal.*

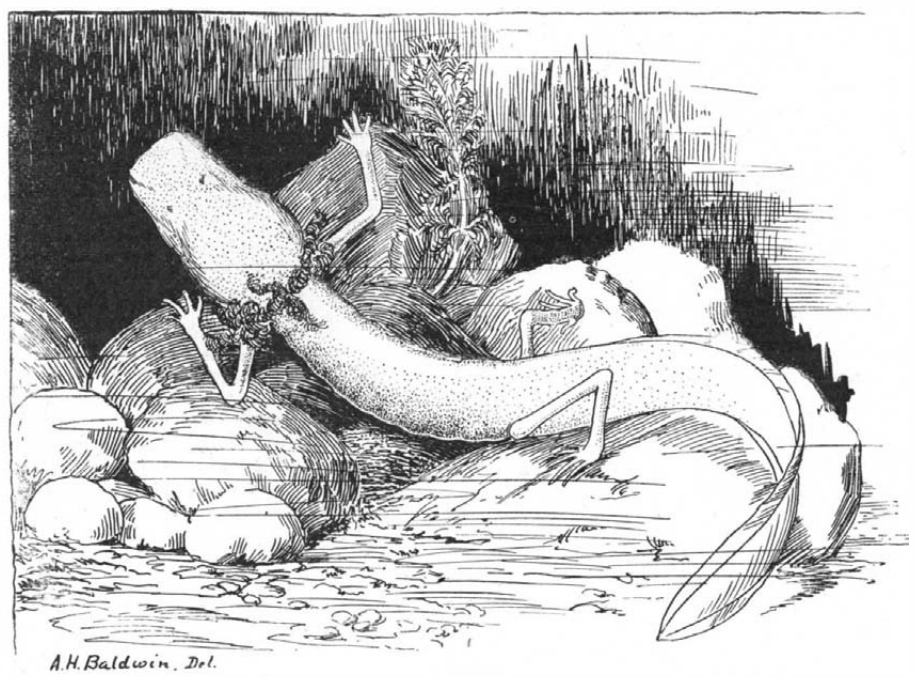


Fig. 2.—TYPHLOMOLGE RATHBUNI. (Drawn from life.)

* From "Report of Fur Seal Investigations," 1896-97.

Space forbids a consideration of the many questions suggested by the Typhlomolge. It may be a link to by-gone ages that became engulfed in some great convulsion, and, though able to exist in its unfavorable environment, was unable to evolve into the modern type. The source and nature of its food, as well as that of the shrimps, is an interesting problem, but its ability to stand variations of pressure is wonderful. A spouting well 188 feet deep indicates a pressure of six atmospheres, ignoring friction, yet these beings can live at the surface. Two of them were shipped from San Marcos to Washington in an ordinary preserving jar, and not only survived the journey but lived for two months or more, seemingly unaffected by light or the diminished pressure. No discovery of recent years is of greater interest to biologists or geologists than that of these little beings, unlike anything else on earth.

Ichthyology and its allied sciences are being studied now as never before. The economic value of the fisheries has made them of national importance, and the resources of governments are being used to promote the study of the water and its inhabitants. Chief among the agencies of research stands the United States Fish Commission, an organization unlike any other in the world. Originally established to inquire into the condition and needs of the fisheries, its scope has been steadily enlarged as its utility and activity were recognized, and its records are now a splendid monument of American science. The investigations of the "Albatross" take high rank even when compared with the epoch-making "Challenger," and in every department it is worthy the praise so freely given it abroad.

FROM a series of experiments made on different plants, E. C. Teodoresco finds that if a plant is grown so that the lower leafy part of the stem is exposed to light, while the terminal bud is in the dark, the results, as regards the development of the vegetative parts, are intermediate between plants grown completely in the light and those grown completely in the dark. In a plant thus partially illuminated, the development of the conducting tissue and the lignification of the walls of the mechanical tissue approach more nearly to those in a plant grown entirely in the dark. In a plant entirely deprived of light, starch is altogether wanting in the tissues of the stem; while in one partially illuminated it is present, though in smaller quantities than in a plant grown entirely in the light. The carbohydrates elaborated in the leaves exposed to light may accumulate in the parts of the plants which are not directly exposed to light.—Bonnier's Rev. Gén. de Botanique.

February Building Edition.

The issue of the Building Edition for February is of great interest and beauty. The colored cover represents a modern dwelling at Hartford, Conn., and the engravings on the inner pages of the publication show additional exterior and interior views. There are a number of various-priced houses in this issue, and among the attractive features is a full-page engraving of the new University Club, New York city. The literary contents include "A Lost Principle of Beauty in Architecture" and "British and Dutch Architecture in South Africa."

The Current Supplement.

The current SUPPLEMENT, No. 1259, has many papers of great value. "A Plea for American Archæology" is a paper by Prof. Charles P. Bowditch, of Boston, and is accompanied by an elaborate series of illustrations of antiquities at Yucatan. "The Schneider-Canet Naval Turrets" describes ships' turrets worked by electricity, using a central ammunition tube. The abstract of the "Report of the Committee on Canals of New York State" is continued. "Old Paris at the Exposition of 1900" is illustrated by charming engravings. "An American Pacific Cable" is by George Owen Squier. "The Cruise of the 'Albatross'" is a letter of A. Agassiz.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

CUTTING APPARATUS.—Samuel Pierson, Hardesty, Oklahoma Territory. This cutting apparatus for mowers and other harvesters embodies improvements in the arrangement and construction of the elements of the cutting apparatus to secure greater efficiency. The inventor has provided an extra long sickle-head and a correspondingly wide shoe, thus affording a large slide surface and reducing the usual excessive friction. The construction and arrangement keep the cutting edges of the knives and guards in true alinement by preventing the wear in the sickle-head and lengthening the period of usefulness.

Engineering Improvements.

ROTARY ENGINE.—George A. Culver, Glenwood, Iowa. An abutment is pivoted in the cylinder wall of the engine and is adapted to swing inwardly with its free end against the periphery of the piston. The piston head swings the abutment outwardly in order that it may pass. The abutment is provided with a segmental arm extending outwardly and moving in a cushioned chamber. A steam-chest has a port leading to the cylinder adjacent to the free end of the abutment. A valve operated from the piston-shaft controls the port, and a connection between the steam-chest and cushioned chamber imparts an inward swinging motion to the abutment. When the piston-head swings an abutment out, the corresponding arm is forced against the steam so that the abutment is cushioned.

STEAM-ENGINE. — Moses R. Robbins, Victoria, British Columbia, Canada. The invention provides an arrangement by which the usual slide-valve of a steam-engine cylinder is dispensed with and in which the piston is fitted with valve mechanism serving alternately to admit steam to each side of the piston, the piston also serving to control the exhaust-valve by direct contact.

Mechanical Devices.

AUTOMATIC FURNACE. — Rudolph Ruetschi, Argentine, Kans. An endless traveling grate has pivoted grate-bars arranged to form a continuous support for the fuel at the upper run and also open spaces between adjacent grate-bars at the lower run for the passage of ashes and coal-dust. The grate is inclined; and the grate-bars are arranged in step-form on the upper run. The fuel on the lowermost grate-bars of the upper run burn briskly while the fuel on the uppermost grate-bars of the upper run is coked by reason of a partial exclusion of air. This coked fuel readily ignites as the grate-bars descend into the fire-box.

ENGRAVING-MACHINE.—John F. Murphy, Bayard, Iowa. This invention provides an ingenious engraving-machine for engraving letters, words, names, or designs from a given pattern on a metal surface. A relatively large pattern is used, and a tracer is made to follow the lines of the pattern and to transmit its motions exactly to an engraving-tool made to engrave the pattern on a reduced scale of any size.

WRENCH.—James A. Montgomery, Brookwood, Ala. The wrench has a fixed and movable jaw and a shank threaded for a portion of its length, to receive a sleeve-nut. The movable jaw is constructed in sections, one of which slides on and completely incloses the shank. The shank is engaged by the sleeve-nut, the upper edge of which fits closely upon the lower edge of the section. The combined length of the section and nut is so much greater than the length of the threaded portion of the shank, so that this threaded portion will always be covered, thereby protecting the threads from dust and other foreign matter.

WOOD-SAWING MACHINE.—Milton R. Spencer and Daniel W. Neal, Sisson, Cal. The machine is particularly adapted for sawing felled timber into suitable lengths for railroads, It comprises a base-beam, one end of which can be rigidly connected with a log. On the opposite end of the base-beam legs are mounted to swing and are connected with hook-rods engaged by eyes on the base-beam. The saw is operated by a driving gear on the base-beam, so proportioned that the saw is rapidly reciprocated.

POST-HOLE BORER.—Henry Landin, Alger, Ohio. The post-hole borer is characterized by a screw-rod carrying a boring-pod. The screw-rod is engaged by a feeding-nut consisting of two sections mounted to swing relatively to each other. As the screw-rod is rotated the pod is forced into the ground. After a sufficient depth has been attained, the pod is raised, the feeding-nut sections being moved out of connection with the screw-rod. During the boring the loosened dirt will pass into the pod, so that the pod, when raised, may be swung laterally. By releasing its locking mechanism the two sections of the pod will swing apart, allowing the dirt to fall out.

Railway-Appliances.

AUTOMATIC COUPLING FOR RAILWAY-CARS.—Charles Troup, Watseka, Ill. The present invention relates to an improved attachment for the chain to which the coupling-pin employed in the clasp of automatic pivoted jaw-couplers is ordinarily secured. The inventor attaches the chain to an arm projecting from the end of the car directly over the coupler so as to permit its disengagement in case the draw-bar is accidentally pulled out.

Miscellaneous Inventions.

GROUNDING-SHOE FOR ELECTRIC WIRES.—Thomas H. Stokes, Lincoln, Ill. The grounding device comprises a shoe sharpened at its lower end and having a transverse hole for receiving a grounding-wire. By the use of this inexpensive device the end of a wire may be quickly and easily grounded without first digging a hole in the ground.

LANTERN-CARRYING ATTACHMENT.—Robert L. Smith, Palos, Ala. The lantern-carrying attachment can be conveniently secured to the leg of a person on horseback or to the dashboard of a wagon. In order to attach the lantern to the ankle of a horseback rider, sheet-metal loops are rigidly attached to the wire frame of the lantern, and straps are inserted through the loops and are fastened about the ankle.

ACETYLENE-GENERATOR.—John W. Paine and Charles B. Doudna, Bayard, Iowa. The improvements in this generator are found in the means employed for successively emptying a series of carbid-pockets and in the means for holding the carbid a short distance below the surface of the water during the generating process. Within the generating casing a stand revolves, provided with a series of carbid-pockets. A stand-pipe in the generator supports a stand at its upper end, the movements of which are controlled by an especial form of escapement, in turn operated by the movements of the gasometer-bell, to discharge the pockets in accordance with the consumption of gas.

FIRE-ESCAPE.—Frank Vaughan, Elizabeth City, N. C. The inventor has provided a fire-escape apparatus located in a fireproof well forming part of the masonry of the building. The fire-escape consists of cables traveling around upper and lower drums mounted in the well. To the cables, steps are attached, having guide-rollers fitted in vertical guideways. Spring-arms in the guideways at each floor of the building are pressed back by the rollers of the steps, when the steps approach a floor, so as to slacken the speed of the apparatus at the floors. Any of the spring-arms can be thrown into or out of the path of the guide-rollers.

VEHICLE NUT-WRENCH.—Jacob E. Vannote, Lakota, N. D. This wrench is so constructed that it will receive and clasp spindle-nuts of different sizes, so that they will remain engaged with the wrench when detached and thus be retained for convenient replacement upon the vehicle spindles when desired.

TRACKING CONNECTION FOR VEHICLES. — Leigh Watkins, Cripple Creek, Colo. The object of the invention is to construct the axle of a vehicle or the adjacent axles of two vehicles so that all the wheels will run in the same track even when turning corners. The wheel-tracking connection employed comprises two rods having clevises swiveled upon their ends and connected with opposite ends of adjacent axles. In hauling freight over rough mountain roads, where the width of the track is limited and frequent curves are necessary, such a device is of considerable service, especially when the team is composed of a large number of animals and many wagons are hauled.

CHECKING OR UNCHECKING DEVICE FOR HORSES. — Joseph White, Manhattan, New York city. This checking-device is so constructed that it can be operated by a driver while in his seat in order partially or entirely to free a horse's head. The invention will be found particularly useful on trotting-horses, for it is well known that by partly releasing the head of the horse while trotting, he will be enabled to increase his speed. When it is desired to water a horse, the driver, without leaving his seat, can entirely uncheck the horse and again check him after drinking.

COMBINED ASH-BOX AND DUST-PAN.—William S. Anderson, Jasper, Tenn. This device may be used both as a dust-pan and as a shovel for taking up and carrying away ashes out of fireplaces and grates. The device comprises a box having one side hinged to drop downward and adapted to act as a shovel or dust-pan. The hinged side is raised and lowered by a crank-shaft.

BRIDGE FOR MUSICAL INSTRUMENTS.—John N. Beetem, Moredale, Penn. The bridge for musical instruments comprises a base or body from which a series of string-supports extend upwardly. A series of feet extend downwardly from the base or body, each directly in line with one of the string-supports. The improved bridge is light, yet strong. Each string is individually supported and therefore vibrates much more readily than when stretched across the old, solidly-constructed bridge.

STUMP-PULLER.—Solomon J. Fletcher, Cedar Falls, Wis. This stump-puller consists of a standard having two separate members joined at their upper ends by a head-plate and at their ends by a base-plate, and provided with adjustable fulcrums between the members. A sole-brace lies in the plane of the standard and operating lever, and has at its upper end a tenon extending between the standard members and engaging the head-plate. The shoulders at the side of the tenon engage the edges of the standard at their upper end. A chain is secured by one end to the lever and is secured to the stump. The apparatus is cheap in construction and effective in operation.

SUNSHADE FOR HATS.—Jules Gerstle, Manhattan, New York city. The sunshade can be conveniently and snugly applied to a hat of any size or any shape. The shade is self-adjustable. A score or memorandum card is so combined with the shade that it can be detached. When the card is removed, the shade will not be rendered unsightly. The device is particularly serviceable at base-ball and foot-ball games.

HAT-HOLDER.—Frederick W. Hodges, Manhattan, New York city. The inventor has devised a hat-holder adapted to be applied to chairs beneath the seats. The holder is composed of open, wire loops forming spring-clamps to engage the legs of a chair and support the hat. The hat can be removed only from the front of the chair.

TAILLESS KITE.—William H. Hoyt and Claison S. Wardwell, Stamford, Conn. To the back of the kite-body a cross-stick is secured. A web extends longitudinally of the kite at its front, which web supports a vertical stick received by a tubular pin. The kite has a longitudinal dihedral angle, the object of which is to displace the currents of air so that they may freely pass from the surface of the kite, laterally of the fin, the fin operating to divide the air-current equally at each side.

APPARATUS FOR PRODUCING WORT, HOP-BEER, WASHING FILTER-PULP, ETC. — Emil Kersten, Richmond, Va. The inventor has provided a new apparatus for use in breweries for washing and sterilizing the pulp used in filtering or for mashing and hopping. The apparatus agitates and leaches the pulverized or ground malt with water for producing wort and treats the wort with the hops in such a manner as to produce an unfermented liquor of a high quality and in such a state as to facilitate the fermenting process.

BREAK-INDICATOR FOR TWISTING-MACHINES.—George F. Ivey, Forest City, N. C. In twisting a number of strands together to form a single strand, should one of the strands break, the others go on and must be pulled off before the missing strand or thread can be properly pieced up, thereby causing much waste. The inventor divides each side of the twister into two or more sections, each section comprising a series of threads or strands to be twisted into a single strand. The circuit controlling devices of the strands in a section are in electrical connection with a needle or other indicator, so that an operator can immediately ascertain in which section a break occurs.

ROCK-DRILL.—Henry Koch, North Tarrytown, N. Y. The drill is a "rocker-drill" in which the valve is operated directly from the piston. The object of the invention is more effectively to control the feed and exhaust of the steam and to cause the piston to work in such a way as properly to strike the drill upon the work, and to obviate back-suction or "churning" in the cylinder. Exhaust-ports furnish a short passage to the atmosphere, permitting a rapid and effective exhaust and also facilitating entry of air into the cylinder after the piston passes the exhaust-ports. By having the exhaust-port leading directly to the atmosphere, a rapid and easy exhaustion is obtained, as well as free circulation of air, both of which are essential in a truly effective rock-drill.

WINDOW-SHADE FIXTURE.—Matthew A. Marr, Manhattan, New York city. The fixture belongs to that class in which the roller carrying the shade is adapted to be moved up and down. The invention provides a fixture, the brackets and guide-rails of which are so constructed that there can be no lateral play of the brackets. The accidental displacement of the roller from its brackets is also prevented. The roller is provided with a longitudinal spring-yielding bearing to permit its automatic adjustment to possible varying widths between the side rails of a window-casing.

CANDLESTICK.—Charles E. Sherman, Manhattan, New York city. The candlestick is arranged to accommodate differently-sized candles, to permit the candle to burn out completely without danger of setting fire to the surrounding parts, and to collect the drippings without danger of the accumulation of molten wax or tallow upon the matches on the base.

Designs.

CUT-GLASS VESSEL.—Thomas B. Clark, Honesdale, Penn. The leading feature of the design is found in a center cut with facets in imitation of a diamond and rising on a plane-surfaced polygonal figure.

BUTTON.—John W. Simmons, Hagerstown, Md. The button bears the representation of an ant and a human eye. The word "trust" is in practice to be applied to the button directly below the eye, so that the whole device will stand for the words "Anti Trust." The button is to be used for campaign purposes.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS ETC.

Steam Engine Theory and Practice. By William Ripper. London and New York: Longmans, Green & Company. 1899. 8vo. Pp. 398. Price $2.50.

A valuable book admirably illustrated by diagrams and engravings. The author has treated a hackneyed subject in a masterly manner. It should be in the library of every mechanical engineer. It is handsomely printed and bound.

Fowler's Mechanical Engineer's Pocket Book for 1900. Edited by W. H. Fowler. Manchester, England: Scientific Publishing Company. 18mo. Pp. 500. Price 60 cents.

This is one of the largest books for the money we have ever seen. Engineer's pocket books are notoriously expensive, and perhaps justly so, but the work before us, notwithstanding its low price, deserves a place in the library or on the drawing table of every mechanical engineer.

The Use of the Slide Rule. By F. A. Halsey. New York: D. Van Nostrand Company. 1899. 18mo. Pp. 84. Price 50 cents.

Any book which will lighten the labor of the draughtsman will be welcomed. It is a curious fact that many go on in the old beaten track for the want of a little book like this when the slide rule, when once mastered, will be found to largely reduce the drudgery of calculation.

The Bird Stone Ceremonial. By Warren King Moorehead. Being an Account of Some Singular Prehistoric Art Facts Found in the United States and Canada. Saranac Lake: Published by the author. 4to. Pp. 31. 53 engravings.

The author is a well known archæologist, and the publication of a monograph of this kind is a definite contribution to the literature of the science. The subject is an interesting one and is admirably treated.

The Cost of Living as Modified by Sanitary Science. By Ellen H. Richards. New York: John Wiley & Sons. 12mo. Pp. 121. Price $1.

Standards of living, household expenses, food, clothing, etc., are all considered. It is an adequate treatment of an important subject, concerning which the literature is limited.

Building Construction for Beginners. By J. W. Riley. London and New York: The Macmillan Company. 1899. 16mo. Pp. 255. Price 60 cents.

The student will often be benefited by the study of a very elementary book of this kind. Of course American readers have no interest in the Department of Science and Art, which in Great Britain gives examinations in such subjects, but the questions may prove useful.

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Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

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(7825) L. H. S. asks: 1. What is lowest temperature found, and in what found? A. The lowest temperature registered in the open air by any thermometer on the earth is —90 degrees Fah. The lowest gained in the laboratory is 434 degrees below zero Fah., by Prof. Dewar, of London. He did this by evaporating frozen hydrogen in a vacuum. This point is 25 degrees above absolute zero. 2. What is the highest known temperature? A. The highest temperature attained is that of the electrical furnace, probably 6,000 to 7,000 degrees. 3. What is meant by absolute zero? A. Absolute zero is not an arbitrary assumption. Any text book of physics will make that clear. It was determined by the fact that all gases expand and contract alike at the freezing point, at the rate of $\frac{1}{459}$ part of their volume for one degree. Since this contraction is due to loss of heat, it follows that when a gas has contracted 459 parts, it can contract no more; all its heat would be gone. This temperature is the "absolute zero." In Centigrade degrees this point is 273 degrees below the ordinary zero.

(7826) F. W. G. asks: What is meant by an ampere hour? A. An ampere hour means a current of one ampere flowing for a time of one hour.

(7827) A. L. H. asks: 1. If two men on opposite sides of the earth at the equator looked along two parallel lines when the sun was midway between the lines, could either of the two men see the sun? A. Yes, both would see the sun in the same place. It would be rising to one and setting to the other. The distance of the sun is so great that the curvature of the earth makes no difference in his position. 2. Why is it that rubber being a non-conductor of electricity will attract objects? A. Because rubber is a non-conductor it can retain the electricity which is generated upon it, and this electricity will then attract light bodies. If it were a conductor the electricity would flow off as fast as it was generated and no electrical manifestation would be possible. It is only upon non-conductors that electricity can be made to remain. Conductors are insulated in order to retain the electricity upon them.

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Miner's drill and pick, W. Childs 642,677
Miner's safety check box, coal, A. H. Lawfer 642,909
Molding press, E. H. Callaway 642,581
Motion, device for converting reciprocating movement into rotary, W. W. Small 642,637
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Necktie holder, W. F. Nies 642,751
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Nozzle, W. S. Aungst 642,833
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(Continued on page 110)

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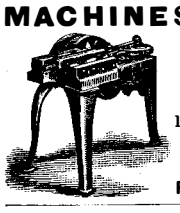

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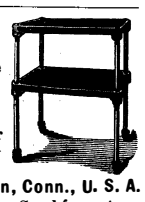

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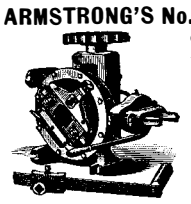

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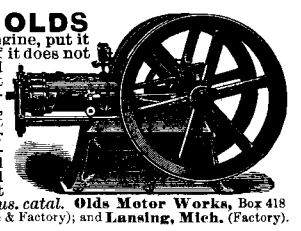

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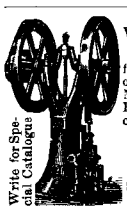
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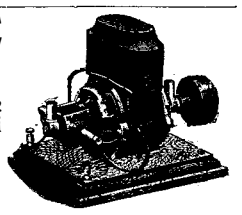

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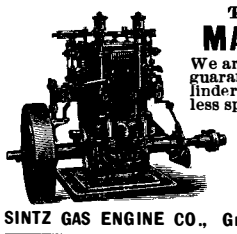

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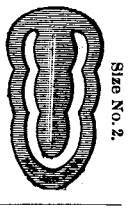
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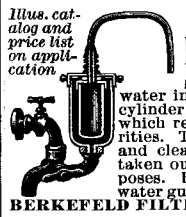

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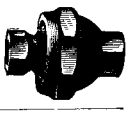

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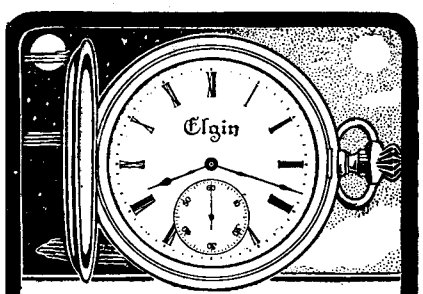

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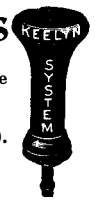

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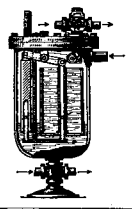

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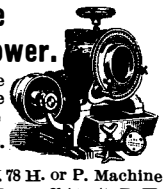

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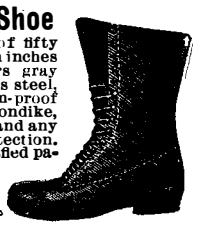

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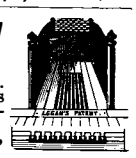

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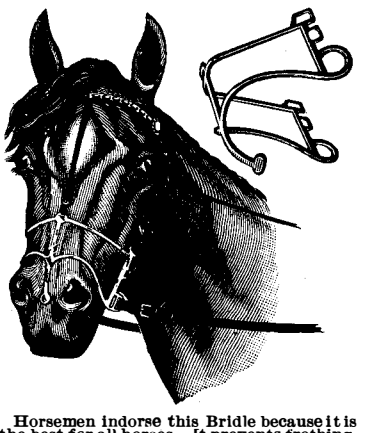

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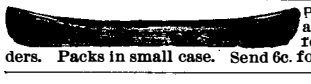

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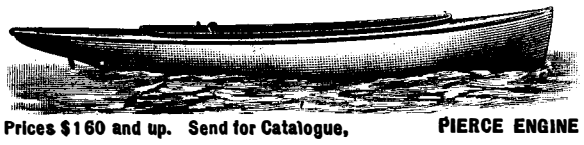

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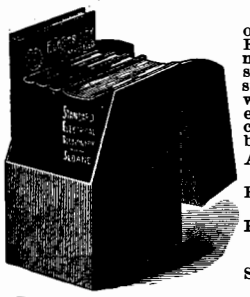

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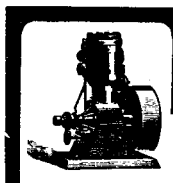

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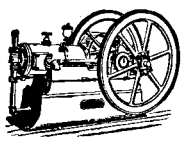

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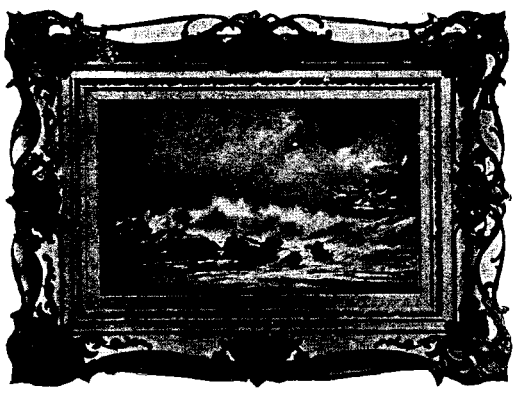

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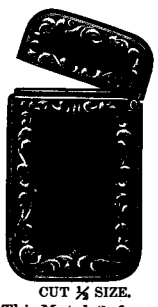

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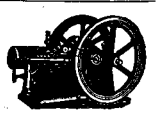

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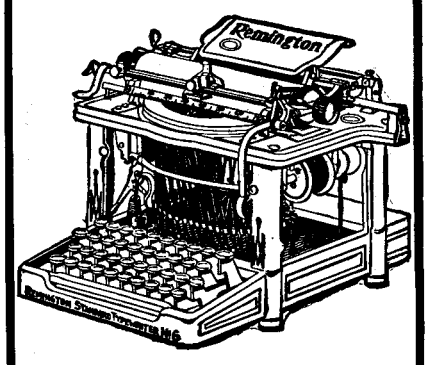

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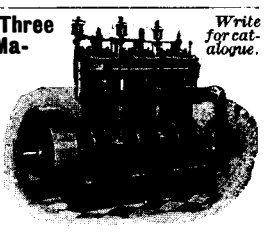

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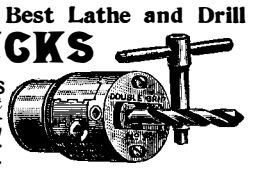

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